Coconino County Multi-Jurisdictional Hazard Mitigation Plan





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This Plan was developed in cooperation with:

Coconino County
City of Flagstaff
Town of Fredonia
City of Page
Town of Tusayan
City of Williams



SECTION 1: INTRODUCTION

1.1 Purpose

This Plan was prepared to guide hazard mitigation to better protect the people, property, community assets and land from the effects of hazards. This Plan demonstrates the communities' and tribe's commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. This Plan was also developed to make the participating communities and tribe eligible for certain types of Federal disaster assistance and hazard mitigation grant funding.

1.2 Background and Scope

Each year in the United States, disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters, because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Many disasters are predictable, and much of the damage caused by these events can be alleviated or even eliminated.

Hazard mitigation is defined by FEMA as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." The results of a three-year congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spend on mitigation saves society an average of \$4 in avoided future losses in addition to saving lives and preventing injuries (National Institute of Building Science Multi-Hazard Mitigation Council 2005).

Examples of hazard mitigation measures include, but are not limited to the following:

- Development of mitigation standards, regulations, policies, and programs
- Land use/zoning policies
- Strong building code and floodplain management regulations
- Dam safety program, seawalls, and levee systems
- Acquisition of flood prone and environmentally sensitive lands
- Retrofitting/hardening/elevating structures and critical facilities
- Relocation of structures, infrastructure, and facilities out of vulnerable areas
- Public awareness/education campaigns
- Improvement of warning and evacuation systems

Hazard mitigation planning is the process through which hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies to lessen impacts are determined, prioritized, and implemented. This Plan documents the planning process employed by the Planning Team. The Plan identifies relevant hazards and risks, and identifies the strategy that will be used to decrease vulnerability and increase resiliency and sustainability.

This Plan was prepared pursuant to the requirements of the Disaster Mitigation Action of 2000 and the implementing regulations set forth in the Federal Register (hereafter, these requirements will be referred to collectively as the DMA2K). While the act emphasized the need for mitigation plans and



more coordinated mitigation planning and implementation efforts, the regulations established the requirements that hazard mitigation plans must meet in order to be eligible for certain Federal disaster assistance and hazard mitigation funding un the Robert T. Stafford Disaster Relief and Emergency Act

Information in this Plan will be used to help guide and coordinate mitigation activities and decisions for future land use. Proactive mitigation planning will help reduce the cost of disaster response and recovery to the community and its property owners by protecting structures, reducing exposure and minimizing overall community impacts and disruption. The community has been affected by hazards in the past and is thus committed to reducing future disaster impacts and maintaining eligibility for Federal funding.

This is a multi-jurisdictional plan that geographically covers the participating communities within the Coconino County boundaries (hereinafter referred to as the planning area). The following communities participated in the planning process:

- Coconino County
- Flagstaff
- Fredonia
- Page
- Tusayan
- Williams

1.3 Assurances

This Plan was prepared to comply with the requirements of the Robert T Stafford Disaster Relief and Emergency Assistance Act of 1988 (as amended by the DMA); all pertinent presidential directives associated with the U.S. Department of Homeland Security and FEMA; all aspects of 44 CFR pertaining to hazard mitigation planning and grants pertaining to the mitigation of adverse effects of disasters (natural, human-caused, and other); interim final rule and final rules issued by FEMA; and all Office of Management and Budget circulars and other federal government documents, guidelines and rules.

The participants of this Plan assure that they will continue to comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c). This Plan will be amended whenever necessary to reflect changes in Federal laws and statutes as required in 44 CFR 133.11(d).

1.4 Plan Organization

This Plan is organized as follows:

- Section 1: Introduction
- Section 2: Community Profile
- Section 3: Planning Process
- Section 4: Risk Assessment
- Section 5: Mitigation Strategy
- Section 6: Plan Maintenance



SECTION 2: COMMUNITY DESCRIPTIONS

2.1 Coconino County

Geography

Coconino County is a topographically diverse area with a wide range of climatic conditions, vegetation and wildlife. Located in north-central Arizona, as depicted in Figure 4-1, the county is larger than many states and encompasses over 18,600 square miles. The county is characterized by deep canyons and rugged mountains with elevations that range from 1,350 feet at the bottom of the Grand Canyon to 12,633 feet at the top of the San Francisco Peaks. The majority of the county is located between 5,000 and 7,000 feet in elevation. Coconino County limits generally lie between longitudes 110.75 to 113.35 ° west and latitudes 34.26 to 37.01 ° north.

The county is characterized by many watercourses. The more prominent perennial watercourses include the Colorado River, Oak Creek, Chevelon Creek, Kanab Creek, and West and East Clear Creek. There are also numerous ephemeral watercourses that drain into the more prominent watercourses. Coconino County is also populated by several natural and man-made lakes that serve as critical water supply sources for both humans and wildlife.

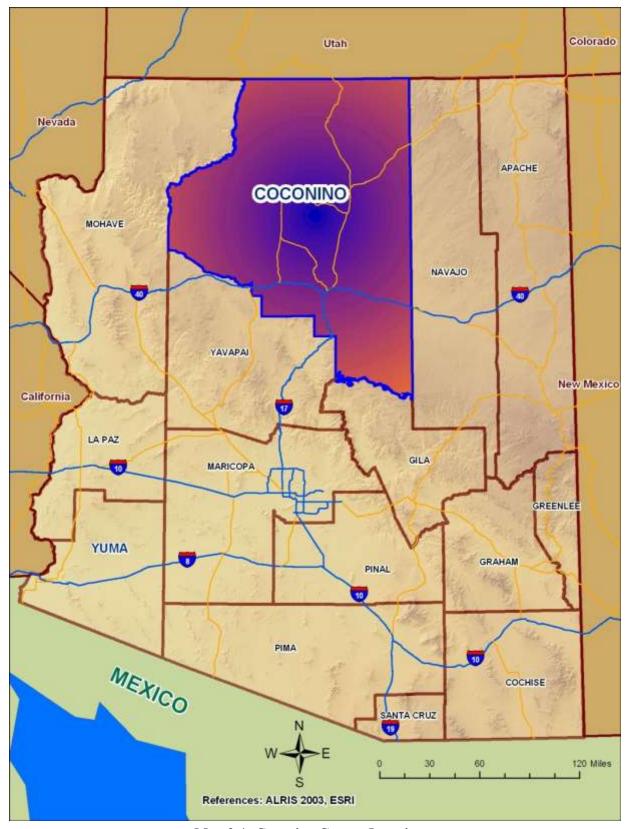
Several major transportation corridors pass through the county including Interstates 17 and 40 and the Burlington-Northern Santa Fe (BNSF) Railway. AMTRAK also operates on the BNSF lines and maintains depots in Flagstaff and Williams. Other major roadways include U.S. Highways 160 and 180, State Routes 64, 66, 67, 87, 89, 89A, 98, 99, 260, and 264, and Indian Routes 2, 15 and 18. The City of Flagstaff operates Flagstaff-Pulliam Airport, which is the largest commercial airport in the county. Other commercial airports are located in Grand Canyon National Park and Page. Smaller, general aviation airports are located in Tuba City, Williams, and Valle.

The terrestrial land characteristics of Coconino County are quite diverse, ranging from sparsely vegetated shrublands to dense pine forests, with small areas of desert scrub at the lower altitude extremes of the county. The land and ecological characteristics of Coconino County have been mapped into three terrestrial ecoregions¹, which are described below:

- Arizona Mountain Forests contains a mountainous landscape, including the Mogollon Rim and the San Francisco Mountains, and covers approximately 40% of the county. The forested regions are located along the southern border of the county running diagonally from southeast to northwest, and along the upper regions of the North Kaibab Plateau. Elevations in this zone range from approximately 4,000 to just under 13,000 feet, resulting in comparatively cool summers and cold winters. Vegetation in this ecoregion is comprised largely of a mix of Scrub Grassland, Mogollon Chaparral Scrubland, Great Basin Conifer Woodland, Rocky Mountain Conifer Forest, and Plains Grassland.
- Colorado Plateau Shrublands covers approximately 55% of the county with elevations that average around 4,000-5,000 feet. Vegetation in this ecoregion is comprised mainly of Plains Grassland and Great Basin Desert scrub. Temperatures can vary widely in this zone, with comparatively warm summers and cool winters.
- **Mojave Desert** covers a very small area of the western-central county, with elevations that range from 1,500 4,000 feet on some mountain locations. Typically the climate in this ecoregion is very hot and dry during the summer and comparatively warm during the winter.

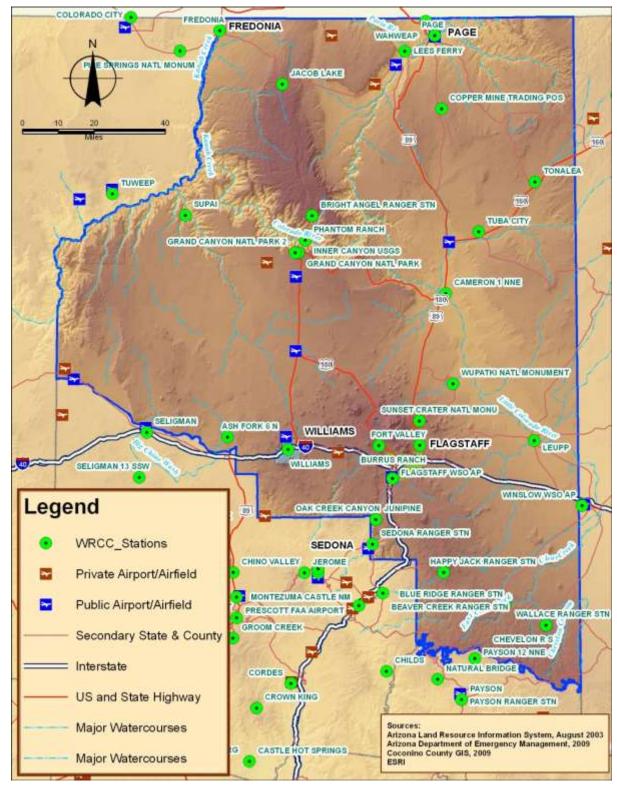
¹ ADEM, November 2007, State of Arizona Multi-Hazard Mitigation Plan





Map 2-1: Coconino County Location





Map 2-2: Coconino County Geographic Features & Transportation Routes





Map 2-3: Coconino County Terrestrial Ecoregions



Climate

The climate in Coconino County varies with location and elevation. Summer characteristics across the county range from hot and dry at the bottom of the Grand Canyon to moderate temperatures within the forested areas. Winter temperatures range from just above freezing to single digit temperatures in the upper mountain areas. Climatic statistics for weather stations within Coconino County are produced by the Western Region Climate Center (WRCC) and span records dating back to the early 1900's. Statistics for the Flagstaff WSO AP, Page, and Phantom Ranch Stations are provided in the following discussions.

Average temperatures within Coconino County vary widely depending upon location and elevation. County-wide, temperatures range from well below freezing during the winter months to nearly 100°F during the summer months. Average extreme temperatures can exceed either end of the spectrum by as much as 10-15°F.

Annual precipitation across Coconino County varies significantly with both location and elevation. Also, for most of the county, precipitation comes in the forms of rain and snow. In general, average rainfall across the county ranges from 6-25 inches. Average annual snowfall totals can range from zero to 100 inches and greater for locations above 7,000 feet.

From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest (Gulf of California) and aloft from the southeast (Gulf of Mexico). The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms².

Table 2-1: Average Climate Data for Flagstaff												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg High (F)	43	45	50	58	67	77	81	78	73	63	52	43
Avg Precip (Inches)	2.13	2.32	2.24	1.26	.63	.43	2.36	3.46	2.56	1.89	1.81	2.05
Avg Snowfall (Inches)	18	17	15	7	0	0	0	0	0	2	7	11
Source: U.S. Climate Data website, May 2015												

Population

Coconino County includes six incorporated communities; Flagstaff, Fredonia, Tusayan, Page, Sedona, and Williams. All or portions of the Navajo Nation, Hopi Indian Tribe, Hualapai Tribe, Kaibab-Paiute Tribe, San Juan Southern Paiute, and all of the Havasupai Tribe are also located within the county boundaries. A total of 45 unincorporated communities, shown below, are scattered across the county, with many being comprised of only one structure or a prominent landmark. According to the Coconino County Arizona profile 12.27% of the land in Coconino County, or 2,326 square miles, is owned by individuals or corporations. About three-fourths of the private land is in large ranches

2



held by about ten owners. Tribal lands comprise 39.11% Forest Service 27.19%, Bureau of Land Management 5.09%, National Park Service 6.87%, and State 9.42%.

Table 2-2: Population Estimates for Coconino County						
Jurisdiction	1990	2000	2010	2020	2030	
Coconino County	96,591	116,320	134,679	144,320	154,380	
Flagstaff	45,857	52,894	65,985	74053	81994	
Fredonia	1,207	1,036	1,312	1,307	1307	
Page	6,598	6,809	7,253	7,738	8,110	
Sedona	7,720	10,192	11,629	12,829	13,776	
Scuolla	7,720	(2,963)	(2,829)	(2,953)	(3,144)	
Tusayan		562	558	550	550	
Williams	2,532	2,842	3,032	3,076	3,139	

Source: https://population.az.gov/population-estimates.

Note: Sedona populations in parenthesis indicate population in Yavapai County.

Economy

Coconino County was crossed by Spanish expeditions during the 16th, 17th and 18th centuries, and by fur trappers and traders in the 1820s and 1830s. Cattle and sheep ranching were started in the 1870s, and when the railroad began serving the area a decade later, the lumber industry boomed.

Coconino County was carved out of Yavapai County by the 16th Territorial Assembly in 1891. That same year, an election was held to determine the permanent county seat. Flagstaff, which had been designated the temporary county seat, won out over Williams by a vote of 419 to 97. In 1891, the population of Coconino County was 4,000. Flagstaff remains the county seat, and the original county courthouse, with additions, is still in use.

The Coconino County civilian labor force in December 2014 was 73,330, up 1.9% from December 2013. The unemployment rate as of December 2014 is 7%. This is down 6.1% from December 2013. The major industries of the county are services and public administration. Tourism also plays a significant role in the county and Flagstaff is a primary hub to such attractions as the Grand Canyon National Park, Oak Creek Canyon, Sunset Crater National Monument, Snowbowl Ski Area, Lake Powell, and prehistoric Indian ruins at Wupatki, Walnut Canyon, and the Navajo National Monument. Coconino County is also home to Northern Arizona University and two Coconino Community Colleges.

In recent years, Flagstaff has experienced moderate growth and development. The Flagstaff Regional Plan 2030, identifies several policies and regulations to guide economic development within the Flagstaff region. These include preserving resources of ecological value in the region including washes, canyons, mountains, steeply sloped hillsides and mesas, riparian areas, volcanic cinder cones and calderas, and their protective buffers. This effort at preservation of these features often coincides or parallels hazard mitigation efforts.



The Metropolitan Statistical Area Flagstaff civilian labor force in 2014 was 71,600 with an unemployment rate of 5.2%. The major industries of the city are government, education, transportation, tourism, services, and retail trade. Flagstaff is home to Northern Arizona University.

Flagstaff's Regional Plan³ identifies a policy to address natural hazards such as wildfire, flooding, unstable soils, seismic or subsidence areas, high winds, and steep slopes among other hazards. The strategies developed to address this policy includes increasing public awareness, hazard identification, design for public safety, redevelopment plans, cooperative planning efforts, limit development in hazard areas, structural hazard mitigation, and wildfire fuel reduction among other strategies.

Development Trends

Coconino County desires to "ensure that policies, plans, and land use regulations accommodate the various needs of people, households, and businesses, and also acknowledges relevant trends influencing how business and industry will utilize land and buildings in the future". A strong economy is vital to the future of Coconino Count and quality of life for County residents. Land use in regard to economic development is important.

Coconino County recognizes that limitations on development related to service and infrastructure may exist within the County. In the unincorporated areas of the County, limited infrastructure presents challenges to economic development in regard to new development of roads, water sources, and wastewater systems. Economic conditions are taken into account to help identify strengths and weaknesses, and identify strategies for diverse economic development to enhance a resilient and vital economy for future generations.

Coconino County takes an active role to encourage new commercial and industrial development regarding the coordination of land use, including the formation of public-private partnerships. The Bellemont area provides opportunities for industrial economic development. Infrastructure improvements to roads, water, and wastewater would be necessary to fully develop se industrial-zoned land parcels. Rezoning can be used to expand commercial and industrial uses when tied to viable development projects. The Interstate 40 corridor east of Flagstaff toward Winslow is one such example. In Williams and Fredonia, land suitable for new commercial and industrial activity underwent annexation to provide infrastructure and capture tax benefits for the municipalities. Coconino County encourages Adaptive Reuse of vacant buildings and underutilized properties which serves several purposes. Adaptive Reuse makes good economic sense and an effective style of development for communities with a limited supply of private land.

Coconino County's transportation corridors are an obvious place for continued development because of their location along shipping routes, providing potential for distribution hubs. Much of the existing commercial and industrial zoning and development in the County is found along such corridors. The County supports development near these corridors but opposes strip-style development which can impede traffic, impact view sheds, and limits opportunities for multimodal transportation. Instead, clustered commercial and industrial development with access to major corridors is preferred.

State Trust lands, especially around Flagstaff, are a possible source development land to increase the availability of private land. Denser zoning for residential development may also allow for more economic use of the existing private lands. Allowance of more agriculture on properties so families can reduce their food expenditures may contribute to lower cost of living expenses. Outlying areas around Flagstaff face similar needs. The Coconino County Comprehensive Plan clearly states "The practice of developing residential properties in the rural areas, most commonly created by ranchlands into 40-acre lots that are then split ten-acre parcels without utilities, water, or reliable road

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³ City of Flagstaff, May 2014, Flagstaff Regional Plan 2030 Place Matters



maintenance is not an efficient method of providing residential uses and results in greater impacts on County resources; both environmental and for public services".

Locating residential housing in closer proximity can reduce travel times and dependency on single-occupancy commutes. With changing times and needs many households today have two or more residents traveling to workplace locations far removed from their immediate residential area. Future development opportunities have been studied and presented in completed multi-modal studies for Kachina Village and Doney Park. Another study is underway for the Bellemont area.

In Coconino County the opportunity for mixed uses exists, with the desire to support development that avoids creating large areas or communities that are exclusively residential, commercial, or industrial.

Proactive land use planning combined with sound mitigation concepts can lessen the impact of natural disasters and hazards experienced by Coconino County.

Jurisdictional Overviews

The following are brief overviews for each of the participating jurisdictions in the Plan.

2.1.1 Flagstaff

Flagstaff is located in north-central Arizona, as depicted in Figure 4-10, and is the regional center and county seat for Coconino County. Flagstaff is situated at the southern base of the San Francisco Peaks at an elevation of 7,000 feet. The city is surrounded by pine forests interspersed with large, grassy meadows and occasional stands of aspen and oak. There are several prominent watercourses that pass through Flagstaff including the Rio de Flag, Sinclair Wash, Schultz Creek, and Walnut Creek.

Several major transportation corridors pass through Flagstaff including Interstates 17 and 40 and the Burlington-Northern Santa Fe (BNSF) Railway. AMTRAK also operates on the BNSF lines and maintains depots in Flagstaff and Williams. Other major roadways include U.S. Highways 180 and 89, and State Routes 66 and 89A. The City of Flagstaff also operates Flagstaff-Pulliam Airport, which is the largest commercial airport in Coconino County and northern Arizona.

According to the city's website⁴, in 1855 Lieutenant Beale, in surveying a road from the Rio Grande in New Mexico to Fort Tejon in California, passed over the spot where Flagstaff now stands. While camping at the Eastern extremity of the present town, the lieutenant had his men cut the limbs from a straight pine tree in order to fly the United States flag. The Town's first recognized permanent settler, Thomas F. McMillan, arrived in 1876 and built a cabin at the base of Mars Hill. Flagstaff drew its name from a very tall pine tree made into a flagpole in 1876 to celebrate our nation's centennial. During the 1880's, Flagstaff began to grow, opening its first post office and welcoming the booming railroad industry. The town had timber, sheep and cattle and by 1886, Flagstaff was the biggest city on the main railroad line between Albuquerque and the West Coast. In 1894, Dr. Percival Lowell chose Flagstaff, due to its great visibility, as the site for the now famous Lowell Observatory. Thirty-six years later, Pluto was discovered through the observatory's telescopes. The Arizona Teacher's College began in 1899, later becoming Northern Arizona University in 1966. Route 66 was built through Flagstaff during the 1920's making Flagstaff a popular tourist stop. Flagstaff was incorporated as a city in 1928.

In recent years, Flagstaff has experienced moderate growth and development. The *Flagstaff Regional Plan 2030* identifies several policies and regulations to guide economic development within the Flagstaff region. These include preserving resources of ecological value in the region including

⁴ City of Flagstaff website URL at: http://www.flagstaff.az.gov/index.asp?NID=2



washes, canyons, mountains, steeply sloped hillsides and mesas, riparian areas, volcanic cinder cones and calderas, and their protective buffers. This effort at preservation of these features often coincides or parallels hazard mitigation efforts.

The Metropolitan Statistical Area Flagstaff civilian labor force in 2014 was 71,600 with an unemployment rate of 5.2%. The major industries of the city are government, education, transportation, tourism, services, and retail trade. Flagstaff is home to Northern Arizona University. Tourism also plays a significant role, with the city being a primary hub for such attractions as the Grand Canyon National Park, Oak Creek Canyon, Sunset Crater National Monument, prehistoric Indian ruins at Wupatki, Walnut Canyon, the Navajo National Monument, Snowbowl Ski Area, and Lake Powell.

Flagstaff's Regional Plan⁵ identifies a policy to address natural hazards such as wildfire, flooding, unstable soils, seismic or subsidence areas, high winds, and steep slopes among other hazards. The strategies developed to address this policy includes increasing public awareness, hazard identification, design for public safety, redevelopment plans, cooperative planning efforts, limit development in hazard areas, structural hazard mitigation, and wildfire fuel reduction among other strategies.

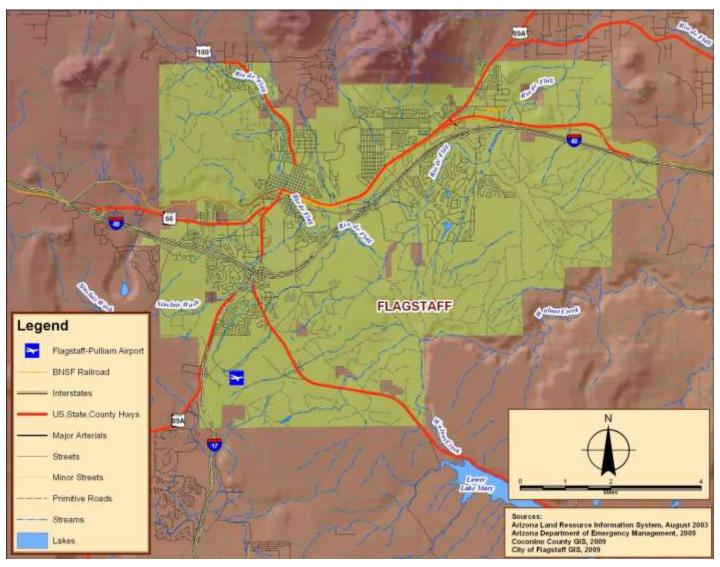
Development Trends

The Flagstaff Regional Plan 2030 emphasizes reinvestment and compact, infill development. This strategy combined with resource protection and management of slopes, forest and floodplain areas ensure as parcels are redeveloped existing hazardous conditions are eliminated and best practices can be implemented. Higher density and intensities are encouraged in urbanized areas, while low density single family uses within the wildland urban interface are properly mitigated utilizing forest management and appropriate construction materials.

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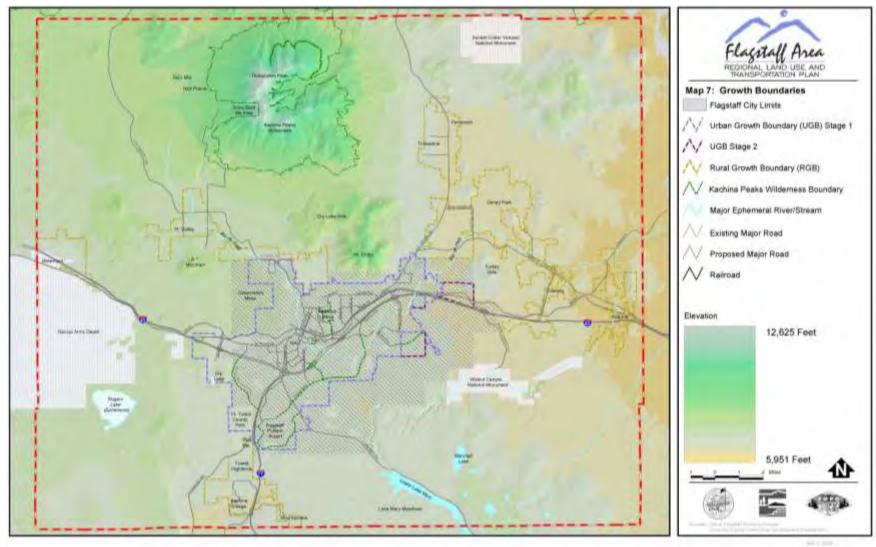
⁵ City of Flagstaff, May 2014, Flagstaff Regional Plan 2030 Place Matters





Map 2-4: City of Flagstaff Location





Map 2-5: Planning Areas within and around Flagstaff



2.1.2 Fredonia

The incorporated Town of Fredonia encompasses an area of approximately 4,400 acres in extreme north-western Coconino County, four miles south of the Arizona-Utah border and north of the Grand Canyon. The elevation for Fredonia is 4,625 ft. The Town was settled in 1885 by Mormon pioneers from southern Utah who capitalized on the available water in Kanab Creek to establish a small agricultural and ranching community. Fredonia is situated on U.S. Highway 89A, in a broad valley at an elevation at 4,800 feet. The west side of the town is defined by Kanab Creek that flows south out of Utah. In its southern reaches, the valley slopes upward into the Kaibab National Forest which was the source of lumber for Kaibab Forest Products. Kaibab Forest Products was the biggest employer in the town. They closed their doors in 1994.⁶⁷

Timber logging, saw mill and mining industries induced modest population growth from about 500 in the mid 1950's to 1040 by 1980. The shut-down of mining activities in the area and a dramatic decline in the logging industry have impacted the community with a loss of more than 300 jobs. In 2014, the town's population remains unchanged at about 1200. Due to the decrease in business (which was a significant decrease in jobs) we have a very limited tax base.

Fredonia is home to Fredonia-Moccasin Unified School District. We have an Elementary School with grades K-6 in the building and a High School with grades 7-12 housed there. We have a wonderful park with softball games in the summer months and also a fantastic summer swim team by the name of Killer Whales (hence we have a pool). We offer the following youth sports: basketball, baseball, football, and volleyball. We also have housed in our wonderful little town a medical center, a library, a senior center, a fire house and a magnificent museum. Another great achievement for the town was the purchasing of its own electrical distribution grid system.

Development Trends

The land use in Fredonia in 2015 is split like this; Residential (65%), Public Use (5%), Commercial (10%), Industrial (5%), and Agriculture (15%). The only new development we have had in the past 21 years is a few businesses coming and then going. Our recent addition to the town is a Family Dollar Store. One of our highlights for public use has been our new shooting facilities. Our major industry until 1994 was Kaibab Industries (logging). When they shut down, our economy went downhill. The economy has never recovered from that loss and also the loss of the mining.

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⁶ Fredonia's Emergency Operations Plan, 1987

⁷ Town of Fredonia's General Plan, 1994





Map 2-6: Town of Fredonia Location



2.1.3 Page

The City of Page is situated in the extreme north-central portion of Coconino County, Arizona, as depicted in Figure 4-13. Page is located at the junction of U.S. Highway 89 and State Route 98 and is adjacent to the Glen Canyon National recreation area (GCNRA). At an average elevation of 4,250 feet, the majority of the city is perched upon a local mesa called Manson Mesa, and is primarily surrounded by the GCNRA and Navajo Nation Indian Reservation lands. The Colorado River and Antelope Creek are the most prominent watercourses near Page. The city itself is totally comprised of private land holdings. The corporate boundary is contiguous with the Glen Canyon National Recreation Area and the Navajo Nation Indian Reservation lands.

According to the City of Page website⁸, the town, which was basically a housing camp for construction workers, was born in 1957 during the building of the Glen Canyon Dam. Navajo land was exchanged for a tract of land in Utah in 1958 to provide land for the "housing camp". The land exchange provided approximately 24 square miles that eventually became the City of Page named after the former Bureau of Reclamation Commissioner John C. Page.

The housing camp originally consisted of temporary homes and house trailers. Permanent homes were eventually constructed which make up some of the existing residential development in Page. Twelve religious organizations were granted building sites for Church buildings which make up "Church Row" today along Lake Powell Boulevard. During the seven years required to construct the dam, Page was a federal municipality. It became an incorporated city on March 1, 1975.

Lake Powell, the Navajo Generating Station, the federal government and tourism are major contributors to the economy in Page. While the recreation oriented firms experience seasonal employment peaks from March through November. Major employers include: ARAMARK, Page Hospital, Yamamoto Custom Baits, Navajo Generating Station/Salt River, Page Steel, Bureau of Reclamation, Coconino Community College, Page Unified School District, City of Page and the National Park Service provide employment throughout the entire year.

The City of Page is a major landowner in the City, and hence has had a tremendous influence on the location of growth. According to the City's General Plan⁹, most of the existing urban development is densely located on Manson Mesa. Development of other areas has been limited due to the City's influence on land ownership, topographical constraints, and characteristics of the infrastructure system. Land on Manson Mesa, however, is 96 % developed which has compelled the City to look at 'off-mesa' areas for future development. The City is currently planning development for areas south of the mesa along Highway 89 and southeast along the Highway 98 corridor.

In the last 10 years, Page has experienced moderate growth and development, with most of the growth being tied to retail trade and tourism. According to the Arizona Department of Commerce¹⁰, there were 289 new buildings permits and a total of \$178.5 million in taxable sales in 2000. In 2007, there were 158 new building permits and a total of \$195.3 million in taxable sales.

⁸ City of Page website URL at http://www.cityofpage.org/history.html

⁹ City of Page, 2009, Draft Page General Plan 2006-2026

¹⁰ City of Page website URL at http://www.cityofpage.org/history.html

¹⁰ City of Page, 2009, Draft Page General Plan 2006-2026

¹⁰ Arizona Department of Commerce , 2008, Community Profile for Page





Map 2-7: Page Location



2.1.4 Tusayan

Tusayan is part of Coconino County and sits at an elevation of just over 6,500 feet. Tusayan is situated at the south entrance of Grand Canyon National Park and is surrounded on the other three sides by the Kaibab National Forest. The Town is surrounded by large pine trees interspersed with grassy meadows and occasional stands of aspen and oak. The Coconino Wash is the prominent watercourse that runs through Tusayan, which is usually dry except for seasonal runoff.

The major transportation corridor to Tusayan is Arizona State Highway 64 that runs north from Williams off of Interstate 40. U.S. Highway 180 runs west from Flagstaff then ties into Highway 64 just south of Tusayan at the small community of Valle. When Highways 64 and 180 connect at Valle they run north to Tusayan then continue traveling through the Grand Canyon National Park then run east to the community of Cameron at Highway 89. The Grand Canyon Railroad runs from Williams through a western section of Tusayan to Grand Canyon National Park. The Grand Canyon National Park Airport is located in Tusayan and is the only airport owned and operated by the AZ Department of Transportation (ADOT). It primarily serves several fixed-base operators who offer sightseeing tours of the Grand Canyon.

According to the book, Grand Canyon's Tusayan Village, by Patrick Whitehurst "no mention of the area would be complete without George Reed." "Reed is often called the founder of Tusayan", as he homesteaded the 160 acres on which the town's business center is currently located. "According to historical records, Reed took possession of the property in April 1920" the same month that Grand Canyon was formally dedicated as a national park.

Reed arrived in northern Arizona in 1905 and "initially worked as a forest ranger in the Tusayan Forest Reserve, an area now known as the Tusayan Ranger District of the Kaibab National Forest." He became well acquainted with the area and "went on to create a lucrative farming business, where Reed grew enough fresh vegetables to provide for his family and to sell to local business." "His crops were especially popular with the hotels along the rim" and "getting supplies to his hungry consumers at the South Rim became much easier for Reed when a new highway was built in 1928.

"Even with the highway, located near where Highway 64 sits today, the rigors of farming grew to be too much for the Reed family." "They sold their interests to the Ten X Cattle Company." "With the new highway came new neighbors for the Reeds." "When the 21st Amendment to the US Constitution ended the nationwide prohibition on the sale of alcohol, Tony Galindo leased a portion of the Reed Homestead to build a bar and tourist motel." "Galindo named the new business the "Tusayan Bar" after the surrounding National Forest." "The State of Arizona, as was the custom, installed a sign along the highway to identify the private property" and "posted a sign near the bar identifying the area as "Tusayan." (Portions taken from an essay by Ronald L. Warren in the Tusayan Area Plan, Coconino County, 1995)

A resort town at the south entrance to the Grand Canyon National Park, Tusayan has a population of 558 according to the 2010 Census. However, an estimated four to five million visitors' travel in Tusayan each year on their way to the Grand Canyon, making Tusayan the most visited little town in northern Arizona. It serves as home base for many of these visitors to relax and replenish from their journey. Tusayan's unemployment rate is very low, since the town is comprised almost entirely of employee housing that requires a person to have a job in order to live in town. The economy consists almost exclusively of the tourism industry with the U.S. Forest Service and cattle ranching contributing to the economy.

Tusayan in the last ten (10) years has experienced little population growth, but continues to develop its tourism based economy. Present day property owners hold onto their land, since there is so little that is privately-owned and the location has excellent exposure to so many tourists. Housing is developed primarily when business concerns need additional employees, who require accommodations in order to operate their new or expanding businesses.



Development Trends

Tusayan's economy is almost exclusively based on businesses serving the many tourists visiting this area, such as hotels, restaurants, gift shops and some entertainment establishments like the IMAX Theater. This economic trend will continue as existing businesses expand their operations and new tourism-related businesses fill in any open space available for development. There are two in holdings in the Kaibab Forest within the Town of Tusayan's corporate limits that are looking to develop additional commercial businesses as well as residential subdivisions. These subdivisions will begin to offer houses for residents to own, thereby changing a predominantly company town with employer-based housing to a residential based community. The Town will develop twenty acres acquired in the Kotzin Ranch development for public housing that will not be tied to any specific business in town, which will with the development of private housing subdivisions encourage this transition to a residential based community. This will allow residents to own their own homes, thereby stimulating the development of community roots, which will encourage greater public involvement in governing bodies such as the school district and the town as well as promote public service organizations that support all facets of a healthy community.





Map 2-8: Tusayan Location



2.1.5 Williams

The City of Williams is located in north-central Arizona and is part of Coconino County and is known as the "Gateway to the Grand Canyon." Williams is situated at the northern base of Bill Williams Mountain at an elevation of 6,940 feet, and is surrounded by the Kaibab National Forest its dense stands of pine trees interspersed with large, grassy meadows and occasional stands of aspen and oak. There are several prominent watercourses that pass through Williams including East and West Cataract Creek, Cataract Wash, and Dogtown Wash.

Several major transportation corridors pass through Williams including Interstate 40 and the Burlington-Northern Santa Fe (BNSF) and Grand Canyon (GCR) Railways. AMTRAK also operates on the BNSF lines and maintains depots in Williams and Flagstaff. Other major roadways include State Routes 66 and 64, and Perkinsville Road. The City of Williams also operates a public airport (H. Clark Memorial Field) which is located north of Interstate 40 and the main city.

According to the Williams Chamber of Commerce's website, one of the early trappers or "Mountain Men" of the American fur trade, William Sherley Williams aka "Old Bill" entered Arizona in the early 1800's. Bill William's was a famous master trapper & scout of the Santa Fe Trail whose favorite retreat was in the area now encompassed by the City of Williams. Sheep and cattle ranchers settled in the valleys and meadows surrounding Bill Williams Mountain after the Civil War. The old neighborhoods of Williams were originally developed by land speculators anticipating construction of a new transcontinental railroad. The Santa Fe Railroad was finished through Williams in 1882 and spurred the growth of the ranching and lumber industries such as the Saginaw Lumber Company of Williams.

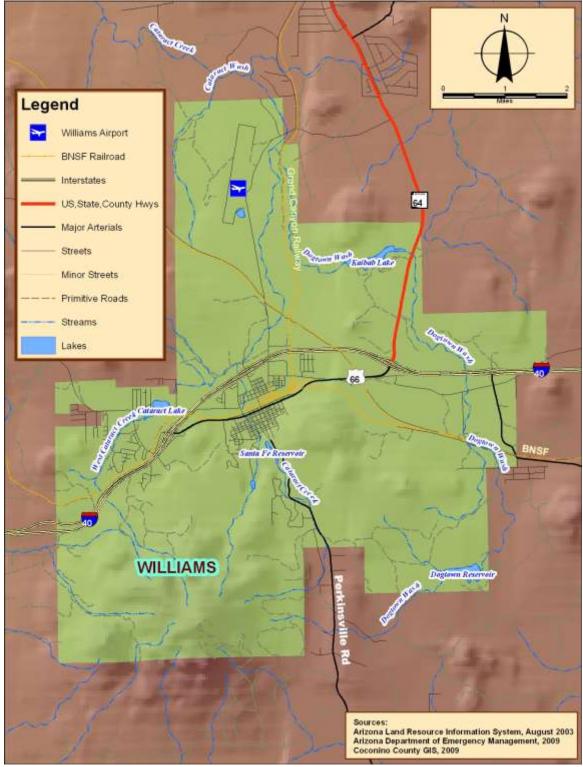
The tourism industry of Williams was spawned by early Buckboard and stagecoach trips to the Grand Canyon. The Santa Fe Railway spur line to the Grand Canyon was completed in September of 1901, establishing Williams as the "Gateway to the Grand Canyon" and host to visitors from around the world. The Grand Canyon Railway carries almost 200,000 visitors a year to the South Rim to this day. The first Post Office was established in 1881 and Williams was incorporated in 1901. In the early 1900s, Williams became known for its saloons, brothels, opium dens and gambling houses. US Highway 66 or "Route 66" was completed through Williams in 1926 which was a major contributor to the tourism industry in Williams. Williams was by-passed by Interstate 40 in 1984 at which time the downtown business district was placed on the National Register of Historic Places.

According to the Arizona Department of Commerce, the Williams civilian labor force in 2013 was 1,794 with an unemployment rate of 7.4%. Tourism forms most of Williams' economic base, with the

U.S. Forest Service, cattle and sheep ranching, small industries and rock quarrying also contributing to the economy. The Grand Canyon Railway is the largest private employer in Williams.

In the last 5 years, Williams has experienced slowed growth and development, with most of the growth being tied to tourism. Taxable sales in Williams increased by approximately \$6.8 million, from 2008 to 2014. The City has identified five primary growth areas in the City of Williams General Plan to provide guidance for growth within the City. The Williams General Plan also identified the need to mitigate traffic, drought, and flood hazards for existing and future residents and facilities as well as visitors.





Map 2-9: Williams Location



SECTION 3: PLANNING PROCESS

3.1 Section Changes

• Detailed planning meetings and activities were omitted. They are now discussed in narrative form and supporting documentation is in the Appendix.

3.2 Primary Points of Contact

Coconino CountyFlagstaffFredoniaRobert RowleyMark GaillardChristy RiddleEmergency ManagementFire Dept.Town Manager's OfficeDirectorDire ChiefTown Clerkrrowley@coconino.az.govmgaillard@flagstaffaz.govtownclerk@fredonia.net

PageTusayanWilliamsJeff ReedWill WrightKyle ChristiansenFire Dept.Town Manager's OfficePublic WorksFire ChiefTown ManagerDirectorfirechief@cityofpage.orgtusayantownmanager@gmail.comkchristiansen@williamsarizona.gov

3.3 Planning Team and Activities

The role of the Planning Team was to perform the review, coordination, research, and planning element activities required to update the 2010 Plan. Attendance by each participating jurisdiction was required at the Planning Team meetings as they were structured to progress through the planning process. Steps and procedures for updating the Plan were presented and discussed at each Planning Team meeting, and assignments were normally given. Each meeting built on information discussed and assignments given at the previous meeting. Members of the Planning Team also had the responsibility of:

- Provide support and data.
- Conveying information and assignments received at the Planning Team meetings to other involved parties within their community.
- Ensuring that requested assignments were completed and returned on a timely basis.
- Make planning decisions regarding Plan components.
- Review the Plan draft documents.
- Arrange for official adoption of the Plan.

Prior to the planning process, Coconino County identified members for the Planning Team by initiating contact with as much of the previous Planning Team as possible. Others that were invited included State Universities and AZ Geological Survey. Contact was made by sending invitations to participate on the Planning Team via email. The invitation also explained the importance of the mitigation plan to build resilience and make our communities safer.

Prior to the beginning of the plan update process, the Mitigation Planner from the AZ Department of Emergency and Military Affairs (DEMA) delivered a four-hour presentation that provided a full review of the current Plan and the update process. DEMA also delivered FEMA's G393 *Mitigation for Emergency Managers* two-day course in Flagstaff. The targeted audience for both of these offerings was the individuals invited to participate on the Planning Team. The purpose of both was to provide an



understanding of the mitigation plan, the purpose and its benefits as well as provide detailed and realistic expectations of the plan update process. Documentation for these events is included in this Plan's Appendix.

The participating members of the current Planning Team are listed below. Only one member of the Planning Team was involved in the previous Plan.

Table 3-1: Planning Team						
Name	Title	Jurisdiction/ Agency	Role			
Nancy Selover	State Climatologist	ASU	Provide information on meteorological hazards and climate change.			
Ken Galluppi	Professor of Practice	ASU	Provided weather and climate related information.			
Hana Putnam	Research Assistant	ASU	Provided weather and climate related information.			
Robert Rowley	Emergency Management Director	Coconino County	Oversee the planning process.			
Dustin Woodman	Public Works, Engineering Division Mgr	Coconino County	Provide flood related information.			
Joe Rumann	Engineering Supervisor, Community Development	Coconino County	Provide hazard relation information.			
Mark Christian	Program Coordinator, Emergency Management	Coconino County	Coordinate the collection of updated data/info from jurisdictions.			
Alan Anderson	Program Coordinator, Emergency Management	Coconino County	Provided County specific information.			
Ruthanne Penn	Emergency Management Administrative Assistant	Coconino County	Provide administrative assistance and meeting coordination.			
Mark Gaillard	Fire Chief/Emergency Mgr	Flagstaff	Provide jurisdiction specific information as well as Hazmat data/information for profile.			
Dan Musselman	Deputy Police Chief	Flagstaff	Provide jurisdiction specific information.			
Bayden Grover	Marshall	Fredonia	Provide jurisdiction specific information.			
Ken Bistline	Fire Chief	Fredonia	Provide jurisdiction specific information.			
Jeff Reed	Fire Chief	Page	Provide jurisdiction specific information.			
Mark Sachara	Fire Chief	Ponderosa Fire Dist	Provided wildfire related information/data.			
Will Wright	Town Manager	Tusayan	Provide jurisdiction specific information.			
Kyle Christiansen	Public Works Director	Williams	Provide jurisdiction specific information.			





Darrell Hixon	Police Lieutenant	Williams	Provide jurisdiction specific information.
Blake Bowen	Emergency Services, Police Dept.	Williams	Provide jurisdiction specific information.
Sue Wood	AZ Dept of Emergency & Military Affairs	State	Guidance/assistance in plan update & meeting requirements.

The Planning Team met for the first time on January 15, 2015 to begin the planning process. Meetings were facilitated and the Planning Team was guided through the update process by the Mitigation Planner at the AZ Department of Emergency and Military Affairs. Two more meetings (Feb and April) were held to step through the plan review and update process. Planning Team members used copies of the 2010 Plan for review and reference. The plan format and hazards were determined by consensus of the Planning Team. However, each jurisdiction determined which hazards posed a significant threat to their own community and used those to work through the Plan with. Additionally, a special meeting was held prior to the February meeting to discuss the impact climate change could have on the area and how it could change future hazard events. Our Planning Team members from ASU facilitated the discussion and part of the intent of it was to determine what types of weather related information could possibly help the local jurisdictions in their planning efforts. Meeting documentation is provided in the Appendix.

An integral part of the planning process included coordination with agencies and organizations outside of the participating jurisdiction's governance to obtain information and data for inclusion into the Plan. Information and data used in the risk assessment may have been developed by agencies or organizations other than the participating jurisdictions. In some cases, the jurisdictions may be members of a larger organization that has jointly conducted a study or planning effort like the development of a community wildfire protection plan. The Planning Team members are usually the individuals reaching out to those others to obtain input, data/information, expertise or direction for use in this Plan.

3.4 Public and Stakeholder Involvement

Public involvement and input to the planning process was encouraged through the course of the pre-draft planning. All participating jurisdictions posted public notices to their respective websites that included a link to the Coconino County website where the current Plan was posted and available for viewing. There was also a link for comments, questions or input. No questions, concerns, or responses were received from the first round of notices from the general public.

A second wave of post-draft public notices were posted to jurisdiction websites and a copy of the draft Plan was posted to the County website for review and comment.

3.5 Program Integration

Over the course of the update planning process, numerous other plans, studies, reports, and technical information were obtained and reviewed for incorporation or reference purposes. The majority of sources referenced and researched pertain to the risk assessment and the capabilities assessment. To a lesser extent, the community descriptions and mitigation strategy also included some document or technical information research. The table below provides a listing of the primary documents and technical resources reviewed and used in the Plan.



Table 3-2:	Resource	Documents	and References
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Table 5-2. Resource Documents and References					
Referenced Document or Technical Source	Jurisdiction /Area Agency	Resource Type	Description of Reference and Its Use		
Coconino Co Comprehensive Plan (2003)	Coconino Co	Comprehensive Plan	County information and existing and future land use planning. Used for community description and development trend analysis.		
Coconino Co Community Area Plans (10 Total – Dates Vary)	Coconino Co	Community Plans	Information and land-use planning for unincorporated community areas throughout the county. Used for development trend analysis.		
Coconino Co Emergency Operation Plan (2013)	Coconino Co	Emergency Operations Plan	Hazard profile data. Used in risk assessment.		
Coconino Co GIS	Coconino Co	GIS Data	County-wide GIS data and supplemental flood hazard data sets. Used for maps and risk assessment.		
Community Wildfire Protection Plan for Flagstaff, Surrounding Communities in the Coconino and Kaibab Nat'l Forests of Coconino Co	Coconino Co	Community Wildfire Protection Plan	Wildfire hazard profile data for hazard mapping and risk assessment		
Community Wildfire Protection Plan, Blue Ridge Area and Mogollon Rim Ranger District of the Coconino Nat'l Forest	Coconino Co	Community Wildfire Protection Plan	Wildfire hazard profile data for hazard mapping and risk assessment		
HazMat Commodity Flow Study Report I-40 Corridor, Arterial Hwys and Railway (2004)	Coconino Co	Report	Amounts and types of HazMat being transported along the I-40 corridor. Used in the risk assessment.		
Flagstaff Fire Department	Flagstaff	Data Source	Historic HazMat, transportation accident, and wildfire incident data. Used in the risk assessment.		
Flagstaff Website	Flagstaff	Website Data	Community description data.		
Flagstaff Hazard Mitigation Plan (2005)	Flagstaff	Hazard Mitigation Plan	Formed the starting point for the update process. See Section 2.4 for further discussion		
Flagstaff Fire Department	Flagstaff	Data Source	Historic HazMat, transportation accident, and wildfire incident data. Used in the risk assessment.		
Flagstaff Website	Flagstaff	Website Data	Community description data.		
Economy of Flagstaff (2008)	Flagstaff	Report	Economic data for the Flagstaff. Used for community description.		
Schultz Fire Full-cost Accounting Report (2013)	Flagstaff	Report	Economic impact of fire and related flooding.		
Greater Flagstaff Area Community Wildfire Protection Plan (2012)	Flagstaff	Plan	Source of wildfire hazard profile data for hazard mapping and risk assessment.		
City of Flagstaff Resiliency and Preparedness Study (2012)	Flagstaff	Plan	Vulnerability assessment focusing on climate and weather related risks.		
Flagstaff Watershed Protection Project Cost Avoidance Study (2014)	Flagstaff	Report	Economic modeling of high vulnerability wildland files in the Flagstaff region.		
Flagstaff Regional Plan (2030)	Flagstaff	Regional Planning Document	Provides the basis for policies and regulations to guide the physical and economic development within the Flagstaff Region.		
Flagstaff Area Regional Land Use and Transportation Plan (2001)	Flagstaff	Plan	Land use and transportation planning information used in the analysis of development trends and development history.		
United States Census	Flagstaff	Data Source	quickfacts.census.gov		



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Table 3-2. Resource Documents and References				
Referenced Document or Technical Source	Jurisdiction /Area Agency	Resource Type	Description of Reference and Its Use	
Town of Fredonia's General Plan (1994)	Fredonia	Plan	Resource for our community description	
Emergency Operations Plan (1987)	Fredonia	Plan	Source for our Hazards or risks and what mitigations we have in a plan to be to incorporate	
Page Hazard Mitigation Plan (2005)	Page	Hazard Mitigation Plan	Formed the starting point for the update process. See Section 2.4 for further discussion	
Page Website	Page	Website Data	Community description data.	
Page General Plan 2006-2026 (Draft, 2009)	Page	General Plan	Community information and existing and future land use planning for the City of Page. Used for community description and development trend analysis.	
Tusayan Community Wildfire Protection Plan - an At-Risk Community of the Kaibab National Forest in Coconino Co	Tusayan	Community Wildfire Protection Plan	Wildfire hazard profile data for hazard mapping and risk assessment.	
Williams General Plan (2003)	Williams	General Plan	Community information and existing and future land use planning for the City of Williams.	
Williams Hazard Mitigation Plan (2005)	Williams	Hazard Mitigation Plan	Formed the starting point for the update process. See Section 2.4 for further discussion	
Economy of Williams (2008)	Williams	Report	Economic data for the Williams. Used for community description.	
Greater Williams Area Community Wildfire Protection Plan	Williams	Community Wildfire Protection Plan	Wildfire hazard profile data for hazard mapping and risk assessment.	
Williams Chamber of Commerce	Williams	Website Data	Economic and community data for the City of Williams. Used for community description.	
State of AZ Hazard Mitigation Plan (2013)	State	Hazard Mitigation Plan	Hazard information and the state identified hazards were used as a starting point in the development of the risk assessment.	
AZ Dept of Commerce	State	Website Data and Community Profiles	Demographic and economic data for the county. Used for community descriptions	
AZ Dept of Emergency and Military Affairs	State	Data and Planning Resource	Statewide disaster declaration information and hazard mitigation planning guidance and documents.	
AZ Dept of Water Resources	State	Technical Resource	Data on drought conditions and statewide drought management (AzGDTF), and dam safety data. Used in risk assessment.	
AZ State Land Dept	State	Data Source	Statewide GIS coverage (ALRIS) and wildfire hazard profile information (Division of Forestry). Used in the risk assessment.	
AZ Wildland Urban Interface Assessment	State	Report	Wildfire hazard profile data and urban interface at risk communities. Used in the risk assessment.	
Office of the State Climatologist for AZ	State	Website Reference	Weather characteristics for the county. Used for community description.	
Federal Emergency Management Agency (FEMA)		Technical and Planning Resource	Hazard mitigation planning guidance (How-To series), floodplain and flooding related NFIP data (mapping, repetitive loss, NFIP statistics), and historic hazard incidents.	



Table 3-2: Resource Documents and References

Referenced Document or Technical Source	Jurisdiction /Area Agency	Resource Type	Description of Reference and Its Use	
USACE Flood Damage Report (1978 & 1994)		Technical Data	Historic flood damages, used in the risk assessment.	
U.S. Forest Service		Technical Data	Local wildfire data, used in the risk assessment.	
U.S. Geological Survey (USGS)		Technical Data	Geological hazard data and incident data. Used in the risk assessment.	
Environmental Working Group's Farm Subsidy Database (2009)		Website Database	Disaster related agricultural subsidies. Used in the risk assessment.	
National Climatic Data Center (NCDC)		Technical Resource	Weather related data and historic hazard event data. Used in the risk assessment.	
National Integrated Drought Information System (2007)		Technical Resource	Drought related projections and conditions. Used in the risk assessment.	
National Inventory of Dams (2009)		Technical Resource	Database used in the dam failure hazard profiling. Used in the risk assessment.	
National Response Center		Technical Resource	Traffic related HazMat incidents and rail accidents. Used in the risk assessment.	
National Weather Service (NWS)		Technical Resource	Hazard information, data sets, and historic event records. Used in the risk assessment.	
Report on Climate Change and Planning Frameworks for the Intermountain West (2011)		Technical Resource	Western Adaptation Alliance and ICLEI Reference	
Southwestern Region Climate Change Trends and Forest Planning (2010)		Technical Resource	Wildfire reference.	
Standard on Disaster/Emergency Management and Business Continuity Programs (2000)		Standards Document	Used to establish the classification and definitions for the asset inventory. Used in the risk assessment.	
Western Regional Climate Center		Website Data	Climate data used in climate discussion of Section 4	



SECTION 4: RISK ASSESSMENT

4.1 Section Changes

- The Historic Hazard Events (Undeclared) table was omitted from this Plan as it was determined to be unsupportable data.
- Climate Change is addressed in this section.
- Earthquake and Hazardous Materials Incidents were added to this Plan. HazMat was previously included in the Transportation Accidents hazard profile.

The risk assessment for Coconino County and participating jurisdictions was performed using a county-wide, multi-jurisdictional perspective, with much of the information gathering and development being accomplished by the Planning Team. This integrated approach was employed because many hazard events are likely to affect numerous jurisdictions within the County, and are not often relegated to a single jurisdictional boundary. The vulnerability analysis was performed in a way such that the results reflect vulnerability at an individual jurisdictional level, and at a countywide level.

4.2 Hazard Identification

For this Plan, the list of hazards identified in the 2010 Plan was reviewed by the Planning Team with the goal of refining the list to reflect the hazards that pose the greatest risk to the jurisdictions represented by this Plan. The 2010 Plan focused primarily on natural hazards. For this update however, an all-hazards approach was taken and hazards, regardless of type, that pose the greatest risk to the communities, were included. The review included an initial screening process to evaluate each of the listed hazards based on the following considerations:

- Experiential knowledge on behalf of the Planning Team with regard to the relative risk associated with the hazard
- Past events (especially events that have occurred during the last plan cycle)
- The ability/desire of Planning Team to develop effective mitigation for the hazard.

For this Plan, the 2010 Plan disaster events were reviewed and updated. In the previous Plan, non-declared disasters were also presented in table format. The sources used for the information were a wide variety of agencies, many of which used very different data gathering criteria or the criteria could not be determined. Therefore, it was determined this information could not be supported as adequate estimations and would not be continued.

Disaster event sources included Arizona Division of Emergency Management (ADEM), Federal Emergency Management Agency (FEMA), and United States Department of Agriculture (USDA). The data was updated with additional hazard events that have occurred over the last plan cycle. The table below summarizes the federal and state disaster declarations that included Coconino County.



	No. of		
Hazard	Declarations	Fatalities	Damage Costs (\$)
Dam Failure	0	0	\$0
Drought	12	0	\$303,000,000
Earthquake	0	0	\$0
Flooding / Flash Flooding	11	49	\$889,650,000
Severe Wind	0	0	\$0
Snow Storm	7	12	\$14,960,904
Transportation Accident	1	25	\$0
Wildfire	21	0	\$34,070,000

The hazard identification process also included Planning Team discussion of other potential threats to the area. By applying the CPRI (see Vulnerability Assessment Methodology below) rating method to all hazards being reviewed, the Planning Team was able to determine which ones pose a significant enough threat. As a result, Earthquake and Hazardous Materials Incidents (HazMat) were added to the hazard list for this Plan. In the previous Plan, HazMat was included in the Transportation Accidents hazard profile. For this Plan, the HazMat element was extracted and both represent significant threats to the area on their own.

The culmination of the review and screening process by the Planning Team resulted in a revised list of hazards that will be carried forward in this Plan, they are as follows:

Dam Failure

Hazardous Materials Incidents

Wildfire

Winter Storm

Drought

Severe Wind

Earthquake

Transportation

Flooding

Accidents

After the Plan's overall hazard list was compiled, each jurisdiction considered which of those hazards posed a significant enough risk to their specific community to warrant mitigation efforts. Very few jurisdictions did not identify all the above hazards as affecting their communities. Below is a summary of the hazards selected for mitigation by each jurisdiction and will be the basis for each jurisdictions mitigation strategy.

Table 4-2:	Table 4-2: Hazards by Jurisdiction											
	Dam Failure	Drought	Earthquake	Flooding	Hazmat	Severe Wind	Transportation Accidents	Wildfire	Winter Storm			
Coconino Co.	X	X	X	X	X	X	X	X	X			



Flagstaff	X	X	X	X	X	X	X	X	X
Fredonia	X	X	X	X	X	X	X	X	X
Page	X	X		X	X	X	X		X
Tusayan		X	X	X	X	X	X	X	X
Williams	X	X	X	X	X	X	X	X	X

4.3 Climate Change

While climate change is expected to lead to warmer temperatures in both winter and summer in the southwest, there is no clear signal for whether there will be a corresponding increase or decrease in precipitation in this region. Over the past 22 years, Arizona has experienced a prolonged drought occasionally punctuated by a wetter than normal year, which is quite typical for an arid climate. This arid region is characterized by extreme weather events particularly extremes in temperature and precipitation. During the past 22 years, there has been a gradual warming, potentially related to the drought that has resulted in an increasing number of winter rain events, rather than snow. However, there have also been several extremely heavy snow events across Coconino County lasting from 3 to 6 days.

While the global climate models and the downscaled regional models call for warmer temperatures by 2030, 2050, and 2100, they provide no guidance for extreme weather events in the 2-10 year time interval of hazard mitigation plan updates. Even the past record of extreme events has so few occurrences that statistical modeling is not a viable option, and the data do not indicate a progression toward more frequent or more intense events. At this time there is insufficient actionable climate information on which to base mitigation actions. Therefore, most of the mitigation actions in this plan update are based on historical extreme weather events.

4.4 Vulnerability Analysis Methodology

The following sections summarize the methodologies used to perform the vulnerability analysis portion of the risk assessment. Specific changes are noted below and/or in their respective sections.

For the purposes of this vulnerability analysis, hazard profile maps were developed for Dam Inundation, Flooding/Flash Flooding, and Wildfire to map the geographic variability of the probability and magnitude risk of the hazards as estimated by the planning team. Hazard profile categories of high, low, and/or medium were used and were subjectively assigned based on the factors discussed in Probability and Magnitude sections below. Within the context of the county limits, the other hazards do not exhibit significant geographic variability and will not be categorized as such.

Calculated Priority Risk Index (CPRI) Evaluation

The first step in the vulnerability analysis is to assess the perceived overall risk for each of the Plan hazards using a tool called the Calculated Priority Risk Index (CPRI). The CPRI value is obtained by assigning varying degrees of risk to four (4) categories for each hazard, and then calculating an index value based on a weighting scheme. The table below summarizes the CPRI risk categories and provides guidance regarding the assignment of values and weighting factors for each category.

Table 4-3: Calculated Priority Risk Index (CPRI)								
CDDI	Degree of Risk							
CPRI Category	Level ID	Description Index Value						
Probability	Unlikely	 Extremely rare with no documented history of occurrences or events. Annual probability of less than 0.001. 	1	45%				



			1	
	Possibly	 Rare occurrences with at least one documented or anecdotal historic event. Annual probability that is between 0.01 and 0.001. 	2	
	Likely	 Occasional occurrences with at least two or more documented historic events. Annual probability that is between 0.1 and 0.01. 	3	
	Highly Likely	 Frequent events with a well documented history of occurrence. Annual probability that is greater than 0.1. 	4	
	Negligible	 Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). Injuries or illnesses are treatable with first aid and there are no deaths. Negligible quality of life lost. Shut down of critical facilities for less than 24 hours. 	1	
Magnitude/ Severity	Limited	 Slight property damages (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). Injuries or illnesses do not result in permanent disability and there are no deaths. Moderate quality of life lost. Shut down of critical facilities for more than 1 day and less than 1 week. 	2	30%
•	Critical	 Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and at least one death. Shut down of critical facilities for more than 1 week and less than 1 month. 	3	
	Catastrophic	 Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and multiple deaths. Shut down of critical facilities for more than 1 month. 	4	
	Less than 6 hours	Self explanatory.	4	
Warning	6 to 12 hours	Self explanatory.	3	15%
Time	12 to 24 hours	Self explanatory.	2	13/0
	More than 24 hours	Self explanatory.	1	
	Less than 6 hours	Self explanatory.	1	
Duration	Less than 24 hours	Self explanatory.	2	10%
Duranon	Less than one week	Self explanatory.	3	10/0
	More than one week	Self explanatory.	4	

As an example, assume that the project team is assessing the hazard of flooding, and has decided that the following assignments best describe the flooding hazard for their community:

- Probability = Likely
- Magnitude/Severity = Critical
- Warning Time = 12 to 24 hours
- Duration = Less than 6 hours



The CPRI for the flooding hazard would then be:

$$CPRI = [(3*0.45) + (3*0.30) + (2*0.15) + (1*0.10)]$$

CPRI = 2.65 (max 4)

CPRI results for each hazard can be found in their respective hazard profiles.

Asset Inventory

A detailed asset inventory was performed for the 2005 Plan to establish a fairly accurate baseline data-set for assessing the vulnerability of each jurisdiction's assets to the hazards previously identified. The asset inventory was then updated for the 2010 Plan, however was not updated for this Plan. It was believed the perceived changes did not justify the effort it would require. Updates to the asset inventory will be considered based on perceived changes and resources available to perform the analysis, during the next Plan update process.

The asset inventory is generally tabularized into *critical* and *non-critical* categories. *Critical facilities* and infrastructure are systems, structures and infrastructure within a community whose incapacity or destruction would:

- Have a debilitating impact on the defense or economic security of that community.
- Significantly hinder a community's ability to recover following a disaster.

Following the criteria set forth by the Critical Infrastructure Assurance Office (CIAO), the State of Arizona has adopted eight general categories¹¹ that define critical facilities and infrastructure:

- **1. Telecommunications Infrastructure:** Telephone, data services, and Internet communications, which have become essential to continuity of business, industry, government, and military operations.
- **2. Electrical Power Systems:** Generation stations and transmission and distribution networks that create and supply electricity to end-users.
- **3. Gas and Oil Facilities:** Production and holding facilities for natural gas, crude and refined petroleum, and petroleum-derived fuels, as well as the refining and processing facilities for these fuels
- **4. Banking and Finance Institutions:** Banks, financial service companies, payment systems, investment companies, and securities/commodities exchanges.
- **5. Transportation Networks:** Highways, railroads, ports and inland waterways, pipelines, and airports and airways that facilitate the efficient movement of goods and people.
- **6. Water Supply Systems:** Sources of water; reservoirs and holding facilities; aqueducts and other transport systems; filtration, cleaning, and treatment systems; pipelines; cooling systems; and other delivery mechanisms that provide for domestic and industrial applications, including systems for dealing with water runoff, wastewater, and firefighting.
- 7. **Government Services:** Capabilities at the federal, state, and local levels of government required to meet the needs for essential services to the public.
- **8.** Emergency Services: Medical, police, fire, and rescue systems.

¹¹ Instituted via Executive Order 13010, which was signed by President Clinton in 1996.



Other assets such as public libraries, schools, museums, parks, recreational facilities, historic buildings or sites, churches, residential and/or commercial subdivisions, apartment complexes, and so forth, are classified as non-critical facilities and infrastructure, as they would not necessarily have a debilitating impact on the defense or economic security of that community and/or significantly hinder a community's ability to recover following a disaster. They are, however, still considered by the Planning Team to be important facilities and critical and non-critical should not be construed to equate to important and non-important. For each asset, attributes such name, description, physical address, geospatial position, and estimated replacement cost were identified to the greatest extent possible and entered into a GIS geodatabase.

Loss Estimations

Losses were estimated by either quantitative or qualitative methods. Quantitative methods consisted of intersecting hazard map layers with the Asset Inventory map layer and the HAZUS®-MH map layer. Other quantitative methods included statistical methods based on historic data. The loss estimates for this Plan represent the current hazard map layers and asset databases using the procedures discussed below.

Estimated economic loss and human exposure from the hazards identified begins with an assessment of the potential exposure of critical and non-critical assets and human populations to those hazards. Exposure estimates of critical and non-critical assets identified by each jurisdiction are accomplished by intersecting the asset inventory with the hazard profiles. Human or population exposures are estimated by intersecting the same hazards with 2009 population statistics projected from the 2000 Census Data population statistics that have been re-organized into GIS compatible databases and distributed with HAZUS®-MH (HAZUS). There was no effort made to update the population exposure estimations as the Planning Team determined there was not significant enough growth in the past five years to justify the effort it would require. However, updating this information will be considered based on perceived changes and resources available to perform the analysis, during the next Plan update process.

Additional exposure estimates for general residential, commercial, and industrial building stock not specifically identified with the asset inventory, are also accomplished using the HAZUS database, wherein the developers of the HAZUS database have made attempts to correlate building/structure counts to census block data. It is duly noted that the HAZUS data population statistics may not exactly equate to the current population statistics due to actual changes in population, GIS positioning anomalies and the way HAZUS depicts certain census block data. It is also noted that the building stock estimates may severely under-predict the actual buildings present due to growth in the last decade and the general lack of data for some of the more rural communities within the county, and the disparity of the HAZUS estimates for these categories. However, without a detailed, site specific structure inventory of these types of buildings, the HAZUS database is still the best available and the results are representative of a general magnitude of population and facility exposures to the various hazards discussed. Combining the exposure results from the asset inventory and the HAZUS database provides a fairly reliable depiction of the overall exposure of building stock and the two datasets are considered complimentary and not redundant. However, this information should not be taken literally and are at best, estimates.

Table 4-4: Critical a	nd Non-Critical Facilities as of June 2009	
Participating Jurisdiction	Critical Facilities and Infrastructure	Non-Critical Facilities and Infrastructure



	Telecommunications	Electrical Power Systems	Gas and Oil Facilities	Banking & Finance	Transportation Networks	Water Supply Systems	Government Services	Emergency Services	Education	Cultural	Business	Residential	Recreational
Coconino County	59	6	0	0	3	16	26	20	19	12	1	0	0
Flagstaff	0	3	3	0	6	75	24	16	65	17	4	3	3
Williams	0	0	3	1	2	2	6	5	6	15	16	0	0
Page	1	5	3	4	4	8	6	3	10	8	8	0	0

Economic losses to structures and facilities are estimated by multiplying the exposed facility replacement cost estimates by an assumed exposure to loss ratio for the hazard. The exposure to loss ratios used in this Plan is summarized by hazard in each hazard profile. It is important to note that the exposure to loss ratios are subjective and the estimates are solely intended to provide an understanding of relative risk from the hazards and potential losses. The reality is that uncertainties are inherent in any loss estimation methodology due to:

- Incomplete scientific knowledge concerning hazards and our ability to predict their effects on the built environment;
- Approximations and simplifications that are necessary for a comprehensive analysis; and,
- Lack of detailed data necessary to implement a viable statistical approach to loss estimations.

Some of the hazards profiled in this Plan will not include quantitative exposure and loss estimates. The vulnerability of people and assets associated with some hazards are nearly impossible to evaluate given the uncertainty associated with where these hazards will occur as well as the relatively limited focus and extent of damage. Instead, a qualitative review of vulnerability will be discussed to provide insight to the nature of losses that are associated with the hazard. For subsequent updates of this Plan, the data needed to evaluate these unpredictable hazards may become refined such that comprehensive vulnerability statements and thorough loss estimates can be made.

4.5 Hazard Risk Profiles

The following sections summarize the risk profiles for each of the hazards identified in this Plan. For each hazard, the following elements are addressed to present the overall risk profile:

- Description
- History
- Probability and Magnitude
- Vulnerability



4.5.1 Dam Failure

Description

The primary risk associated with dam failure in Coconino County is the inundation of facilities from the flood wave that would result from a Dam Failure. Dams within or impacting the county are primarily storage reservoirs for water supply and possibly power generation and/or for flood control designed to attenuate or reduce flooding by impounding stormwater for relatively short durations of time during flood events. Dam failures may be caused by a variety of reasons including: seismic events, extreme wave action, leakage and piping, overtopping, material fatigue and spillway erosion.

History

Coconino County has a limited history of dam failures that caused damaging inundation of downstream properties. The only historic dam failure uncovered during this planning project was a cattle water tank impounded by what is known as the Redlands Dam described as follows:

• August 16, 2008, heavy rain from thunderstorms over the Cataract Creek and Havasu Creek drainages caused flash flooding that started in the Village of Supai around 11:30 PM on August 16. The flooding lasted several days and caused damage to a few homes in the Village of Supai. There was extensive damage to Havasu Canyon and the campground below the village. Many campers were stranded during the night in trees and on picnic tables. In all, 406 people were flown out of Havasu Canyon by helicopters from multiple public safety agencies (NCDC, 2008). The Redlands Dam on Cataract Creek miles upstream of the Village of Supai breached and was initially assumed to have been the cause of flooding in Supai. However, the breach was later determined to be of little consequence to flooding in Supai. The Dam is only 8-10 feet high and serves as a barrier for a cattle water tank for the Babbit Ranches (Associated Press 8/21/08).

Probability and Magnitude

The probability and magnitude of dam failure discharges vary greatly with each dam. There are two sources of data that publish hazard ratings for dams impacting the County that are based on either an assessment of the consequence of failure and/or dam safety considerations. The hazard ratings are not tied to probability of occurrence. The first is the Arizona Department of Water Resources (ADWR) and the second is the National Inventory of Dams (NID).

ADWR has regulatory jurisdiction over the non-federal dams impacting the County and is responsible for regulating the safety of these dams, conducting field investigations, and participating in flood mitigation programs with the goal of minimizing the risk for loss of life and property to the citizens of Arizona. ADWR jurisdictional dams are inspected regularly according to downstream hazard potential classification. High hazard dams are inspected annually, significant hazard dams every three years, and low hazard dams every five years. Via these inspections, ADWR identifies safety deficiencies requiring correction and assigns each dam one of five safety ratings (listed in increasing severity): no deficiency, safety deficiency, unsafe non-emergency elevated risk, or unsafe emergency. Examples of safety deficiencies include: lack of an adequate emergency action plan, inability to safely pass the required Inflow Design Flood (IDF), embankment erosion, dam stability, etc. Further descriptions of each safety classification are summarized below.



Table 4-5: ADWR Dam Safety Categories						
ADWR Safety Rating	Definition					
No Deficiency	No safety deficiencies found					
Safety Deficiency	One or more conditions at the dam that impair or adversely affects the safe operation of the dam.					
Unsafe Non-emergency	Safety deficiencies in a dam or spillway could result in failure of the dam with subsequent loss of human life or significant property damage. Failure is not considered imminent.					
Unsafe Non-emergency Elevated Risk	Safety deficiencies in a dam or spillway could result in failure of the dam with subsequent loss of human life or significant property damage. Concern the dam could fail during a 100-yr or smaller flood.					
Unsafe Emergency	The dam is in imminent risk of failure.					
Source: ADWR, 2009.						

The NID database contains information on approximately 77,000 dams in the 50 states and Puerto Rico, with approximately 30 characteristics reported for each dam, such as: name, owner, river, nearest community, length, height, average storage, max storage, hazard rating, Emergency Action Plan (EAP), latitude, and longitude. Dams within the NID database are classified by hazard potential that is based on an assessment of the consequences of failure.

Table 4-6: NID Downstream Hazard Classifications									
Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses							
Low	None expected	Low and generally limited to owner							
Significant	None expected	Yes							
High	Probable. One or more expected	Yes (but not necessary for this classification)							
Note: The hezerd notent	1	consequences of failure but not an evaluation of the							

Note: The hazard potential classification is an assessment of the consequences of failure, but not an evaluation of the probability of failure.

Source: NID

The NID database includes dams that are either:

- High or Significant hazard potential class dams, or,
- Low hazard potential class dams that exceed 25 feet in height and 15 acre-feet storage, or,
- Low hazard potential class dams that exceed 50 acre-feet storage and 6 feet height.

There are 49 dams in Coconino County based on the two databases. Of the 49 dams, 33 are under ADWR jurisdiction, and 16 are under federal jurisdiction. The table below provides a summary of the hazard and safety classifications by count for both the ADWR and NID databases.



Table 4-7: NID and ADWR Hazard Classification Dams										
Database Source	High	Significant	Low	Safety Deficiency	Unsafe (any sub-category)					
NID	2	2	5	N/A	N/A					
ADWR	9	3	22	3	3					
Source: ADWR a	Source: ADWR and NID, 2009									

The magnitude of impacts due to dam failure are usually depicted by mapping the estimated downstream inundation limits based on an assessment of a combination of flow depth and velocity. These limits are typically a critical part of the emergency action plan. Of the 43 dams considered, only four emergency action plans were readily available. For inundation resulting from dam failure, two classes of hazard risk are depicted as follows:

HIGH Hazard = Inundation limits due to dam failure

LOW Hazard = All other areas outside the inundation limits

Extents of the dam failure inundation hazard areas are shown on the maps that follow.

Vulnerability – CPRI Results

Table 4-8: CPRI Rating for Dam Failure											
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score						
Coconino Co.	Possibly	Limited	6-12 hours	<24 hours	2.15						
Flagstaff	Unlikely	Negligible	<6 hours	<6 hours	1.45						
Fredonia	Likely	Catastrophic	<6 hours	<24 hours	3.35						
Page	Unlikely	Catastrophic	<6 hours	>1 week	2.65						
Tusayan	Unlikely	Negligible	12-24 hours	<6 hours	1.15						
Williams	Possibly	Critical	<6 hours	<6 hours	2.50						
County-wide average CPRI =											
Note: Maximum CPRI	Note: Maximum CPRI score is 4.00.										

Vulnerability – Loss Estimations

The estimation of potential losses due to inundation from a dam failure was accomplished by intersecting the human and facility assets with the inundation limits depicted on the maps that follow. As stated previously, only four of the 43 dams have a delineated inundation limit downstream of the dam associated with a dam failure. Therefore, the results of this analysis are expected to underestimate the vulnerability of people and infrastructure within Coconino County. For example, no dam failure inundation limits were provided for Glen Canyon Dam (GCD) on the Colorado River near Page. However, a failure of the GCD would be catastrophic. The flood wave from such an event would likely cause the Hoover Dam downstream to fail and flood thousands of properties on its way down to the Gulf of California. To replace both GCD and the Hoover Dam would cost in excess of \$36 billion and the economic losses as a



result of lost water and power to the states benefitting from the Colorado River Storage Project would have a significant impact on the economy of the nation (TriData, 2005).

Since no common methodology is available for obtaining losses from the exposure values, estimates of the loss-to-exposure ratios were assumed based on the perceived potential for damage. Any storm event, or series of storm events of sufficient magnitude to cause a dam failure scenario, would have potentially catastrophic consequences in the inundation area. Floodwaves from these types of events travel very fast and possess tremendous destructive energy. Accordingly, an average event based loss-to-exposure ratio for the inundation areas with a high hazard rating are estimated to be 0.25. Low rated areas are zero.

It should be noted that the Planning Team recognizes that the probability of a dam failure occurring on multiple (or all) structures at the same time is essentially zero. Accordingly, the loss estimates presented below are intended to serve as a collective evaluation of the potential exposure and losses to dam failure inundation events.

The tables that follow summarize a full range of estimations of losses and exposure to/from dam failure. In summary, \$4.2 million in asset related losses are estimated for dam failure inundation for all the participating jurisdictions in the County. An additional \$52.2 million in losses to HAZUS defined residential, commercial, and industrial facilities is estimated for all participating jurisdictions. Regarding human vulnerability, a total population of 2,744 people, or 1.96% of the total 2009 County projected population, is potentially exposed to a dam failure inundation event. The potential for deaths and injuries are directly related to the warning time and type of event. Given the magnitude of such an event(s), it is realistic to anticipate at least one death and several injuries. There is also a high probability of population displacement for most of the inhabitants within the inundation limits downstream of the dam(s).

Vulnerability – Development Trend Analysis

The flood protection afforded by dams in the County has encouraged development of lands immediately downstream of the structures. However, prohibition of development in these areas is not feasible. Instead, public awareness measures such as notices on final plats and public education on dam safety are mitigation efforts employed by local county and city/town officials. Also, Emergency Action Plans (EAPs) that establish potential dam failure inundation limits, notification procedures, and thresholds are also prepared for response to potential dam related disaster events.

Table 4-9: Estimated	Table 4-9: Estimated Asset Losses Due to Dam Failure Flooding										
Total Facilities Reported by Community Community Facilities Impacted Facilities Impacted Facilities Impacted Facilities Impacted Facilities Impacted Facilities Impacted (x \$1000)											
	HIGH										
County-Wide Totals	497	53	10.66%	\$16,905	\$4,226						
Coconino County	162	6	3.70%	\$1,700	\$425						
Flagstaff	219	0	0.00%	\$0	\$0						
Page	60	0	0.00%	\$0	\$0						
Williams	56	47	83.93%	\$15,205	\$3,801						





Table 4-10: Estimated Population Exposed to Dam Failure										
Community	Total Population	Population Exposed	Percent of Population Exposed	Total Population Over 65	Population Over 65 Exposed	Percent of Population Over 65 Exposed				
	HIGH									
County-Wide Totals	139,881	2,744	1.96%	8,906	294	3.30%				
Flagstaff	65,478	0	0.00%	3,347	0	0.00%				
Page	7,283	0	0.00%	393	0	0.00%				
Unincorporated Coconino Co	30,941	114	0.37%	1,994	12	0.58%				
Williams	3,326	2,296	69.04%	356	248	69.62%				





Table 4-11: Coconino Co Estimated Building Exposure to Dam Failure									
	Res	sidential	Con	nmercial	Industrial		Summary		
Coconino Co HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)
County-Wide Totals	50,471	\$8,932,983	2384	\$2,500,987	611	\$389,374	\$11,823,344		
High Hazard Exposure	1,133	\$146,925	88	\$55,307	13	\$6,574	\$208,806	25%	\$52,202
Coconino Co HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact			
High Hazard Exposure	2.25%	1.64%	3.70%	2.21%	2.07%	1.69%			

Table 4-12: Flagstaff Es	Table 4-12: Flagstaff Estimated Building Exposure to Dam Failure										
	Res	Residential		Commercial		lustrial	Summary				
Flagstaff (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)		
Community-Wide Totals	16,521	\$3,918,391	1,320	\$1,485,011	322	\$232,205	\$5,635,607				
High Hazard Exposure	0	\$0	0	\$0	0	\$0	\$0	25%	\$0		
Flagstaff (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact					
High Hazard Exposure	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%					





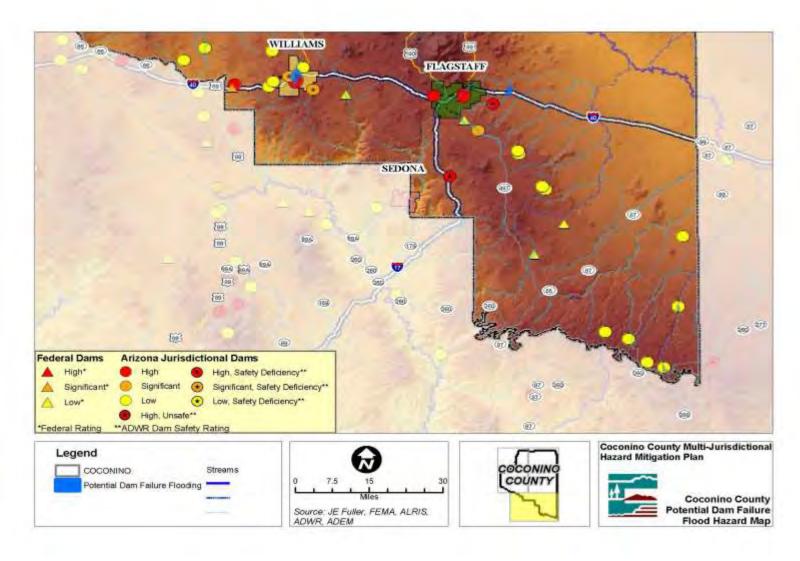
Table 4-13: Page Estimated Building Exposure to Dam Failure										
	Resi	dential	Commercial		Industrial		Summary			
Page (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)	
Community-Wide Totals	2,568	\$383,986	80	\$65,815	13	\$3,671	\$453,473			
High Hazard Exposure	0	\$0	0	\$0	0	\$0	\$0	25%	\$0	
Page (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact				
High Hazard Exposure	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				

Table 4-14: Williams Estimated Building Exposure to Dam Failure										
	Res	sidential	Commercial		Industrial		Summary			
Williams (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)	
Community-Wide Totals	1,469	\$200,380	113	\$69,440	13	\$4,985	\$274,805			
High Hazard Exposure	942	\$126,863	81	\$50,714	9	\$3,637	\$181,214	25%	\$45,304	
Williams (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact				
High Hazard Exposure	64.15%	63.31%	71.61%	73.03%	72.17%	72.96%				



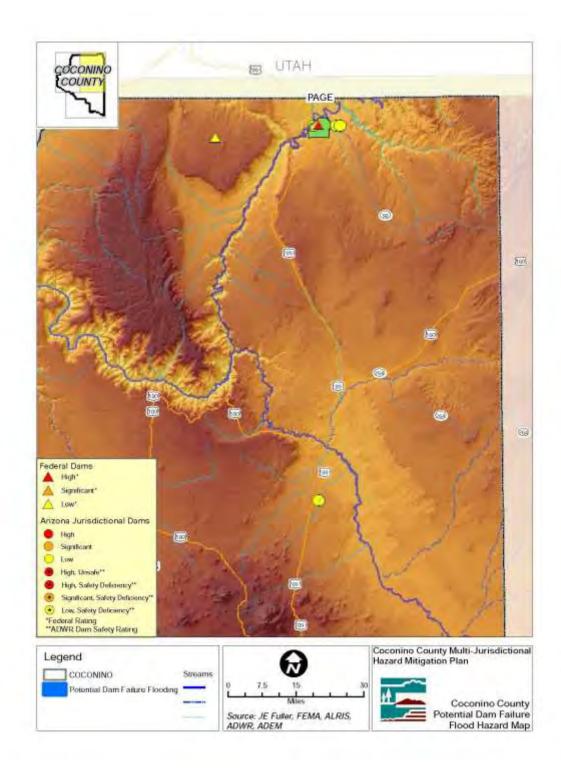
Table 4-15: Unincorporated Coconino Co Estimated Building Exposure to Dam Failure										
	Res	sidential	Commercial		Industrial		Summary			
Unincorporated (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)	
Community-Wide Totals	18,435	\$2,935,368	583	\$445,427	205	\$107,147	\$3,487,942			
High Hazard Exposure	49	\$5,800	1	\$131	1	\$1,228	\$7,158	25%	\$1,790	
Unincorporated (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact				
High Hazard Exposure	0.27%	0.20%	0.10%	0.03%	0.39%	1.15%				





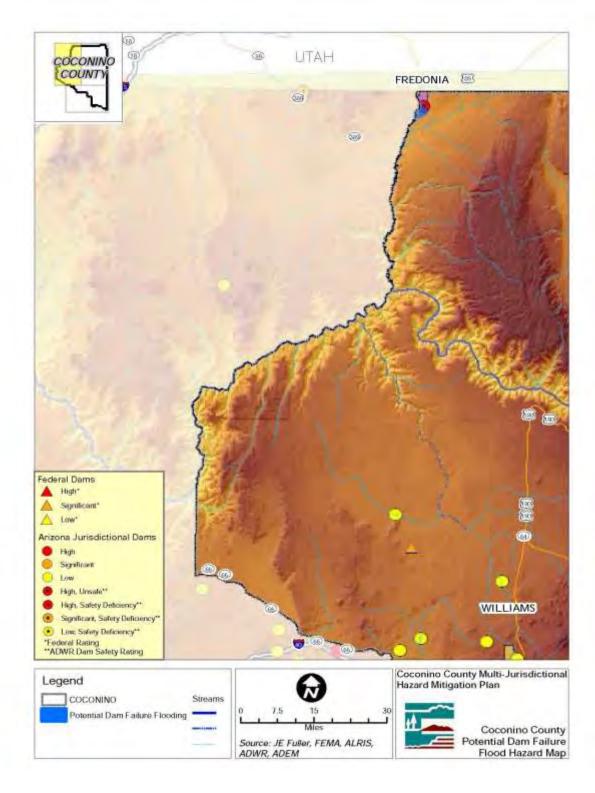
Map 4-1: Potential Dam Failure Flood Hazard 1





Map 4-2: Potential Dam Failure Flood Hazard 2





Map 4-3: Potential Dam Failure Flood Hazard 3



Sources

Arizona Department of Water Resources, 2009, http://www.azwater.gov/AzDWR/SurfaceWater/DamSafety/default.htm

ADEM, 2009, State of Arizona Multi-Hazard Mitigation Plan, 2010 Update, DRAFT.

TriData, May 2005, Coconino County, Arizona, Emergency Operation Plan

US Army Corps of Engineers, National Inventory of Dams, 2009, https://nid.usace.army.mil/



4.5.2 Drought

Description

Drought is a normal part of virtually every climate on the planet, including areas of high and low rainfall. It is different from normal aridity, which is a permanent characteristic of the climate in areas of low rainfall. Drought is the result of a natural decline in the expected precipitation over an extended period of time, typically one or more seasons in length. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity (FEMA, 1997).

Drought is a complex natural hazard which is reflected in the following four definitions commonly used to describe it:

- Meteorological drought is defined solely on the degree of dryness, expressed as a departure of
 actual precipitation from an expected average or normal amount based on monthly, seasonal, or
 annual time scales.
- Hydrological drought is related to the effects of precipitation shortfalls on streamflows and reservoir, lake, and groundwater levels.
- Agricultural drought is defined principally in terms of naturally occurring soil moisture deficiencies relative to water demands of plant life, usually arid crops.
- Socioeconomic drought associates the supply and demand of economic goods or services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of weather-related supply shortfall. It may also be called a water management drought.

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. Due to its multi-dimensional nature, drought is difficult to define in exact terms and also poses difficulties in terms of comprehensive risk assessments.

Drought differs from other natural hazards in three ways. First, the onset and end of a drought are difficult to determine due to the slow accumulation and lingering effects of an event after its apparent end. Second, the lack of an exact and universally accepted definition adds to the confusion of its existence and severity. Third, in contrast with other natural hazards, the impact of drought is less obvious and may be spread over a larger geographic area. These characteristics have hindered the preparation of drought contingency or mitigation plans by many governments.

Droughts may cause a shortage of water for human and industrial consumption, hydroelectric power, recreation, and navigation. Water quality may also decline and the number and severity of wildfires may increase. Severe droughts may result in the loss of agricultural crops and forest products, undernourished wildlife and livestock, lower land values, and higher unemployment.

History

Arizona has experienced 17 droughts declared as drought disasters/emergencies and 93 drought events (droughts affecting multiple years are recorded as a distinct event for each year affected). Between 1849 and 1905, the most prolonged period of drought conditions in 300 years occurred in Arizona (Jacobs, 2003). Another prolonged drought occurred during the period of 1941 to 1965. The period from 1979-1993 appears to have been anomalously wet, while the rest of the historical records shows that dry conditions are most likely the normal condition for Arizona. Between 1994 and 2015 there have been more months and years with below normal precipitation than months or years with above normal precipitation.



Probability and Magnitude

There is no commonly accepted return period or non-exceedance probability for defining the risk from drought (such as the 100-year or 1% annual chance of flood). The magnitude of drought is usually measured in time and the severity of the hydrologic deficit. There are several resources available to evaluate drought status and even project very near future expected conditions.

The National Integrated Drought Information System (NIDIS) Act of 2006 (Public Law 109-430) prescribes an interagency approach for drought monitoring, forecasting, and early warning (NIDIS, 2007). The NIDIS maintains the U.S. Drought Portal¹² which is a centralized, web-based access point to several drought related resources including the U.S. Drought Monitor (USDM) and the U.S. Seasonal Drought Outlook (USSDO). The Palmer Drought Severity Index (PSDI) is a commonly used index that measures the severity of drought for agriculture and water resource management. It is calculated from observed temperature and precipitation values and estimates soil moisture. However, the Palmer Index is not considered to be consistent enough to characterize the risk of drought on a nationwide basis (FEMA, 1997) and neither of the Palmer indices is well suited to the dry, mountainous western United States.

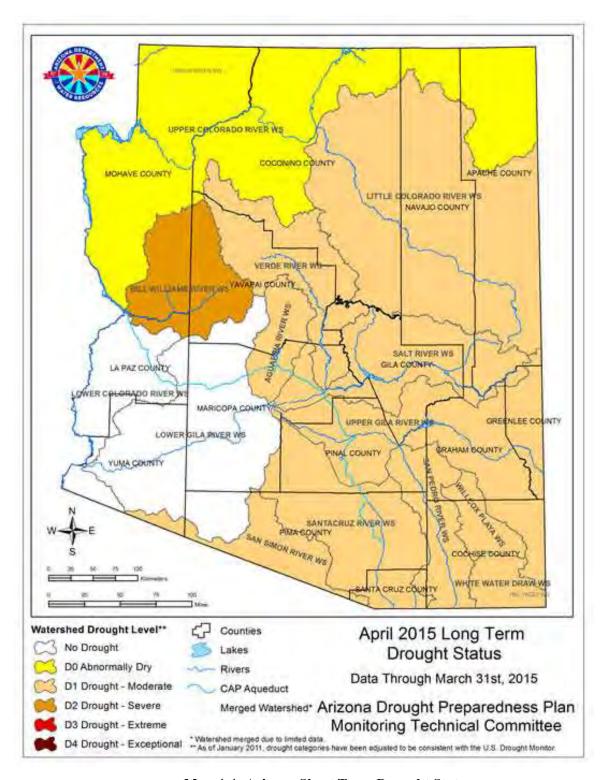
In 2003, Governor Janet Napolitano created the Arizona Drought Task Force (ADTF), led by ADWR, which developed a statewide drought plan. The plan includes criteria for determining both short and long-term drought status for each of the 15 major watersheds in the state using assessments that are based on precipitation and stream flow. The plan also provides the framework for an interagency group which reports to the governor on drought status, in addition to local drought impact groups in each county and the State Drought Monitoring Technical Committee. Twice a year this interagency group reports to the governor on the drought status and the potential need for drought declarations. The counties use the monthly drought status reports to implement drought actions within their drought plans. The State Drought Monitoring Technical Committee uses the Standardized Precipitation Index (SPI) for the short-term drought status and a combination of the SPI and streamflow for the long-term drought status.

Coconino County has experienced drought ranging from abnormally dry to extreme drought over the past five years as winter storms sweep across the northern third of the state one year then stay north of the state in other years, leaving large precipitation deficits. While the current 21 year drought is longer than the 16 year wet period that preceded it, it is still shorter than the 37 year drought of the mid-twentieth century. There are no trends or other indicators that the drought will end soon. Drought in northern Arizona is generally characterized by extreme variability in precipitation from year to year, however the most recent four years have been the second driest 48-month period since the 1950s, and extended dry periods have negative impacts on wildfires and water resources. Drought is likely to continue, as will the extreme variability in precipitation, both summer and winter.

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¹² NIDIS U.S. Drought Portal website is located at: http://www.drought.gov/portal/server.pt/community/drought.gov/202





Map 4-4: Arizona Short Term Drought Status



When attempting to evaluate the probability and magnitude of drought in Coconino County, it is helpful to remember that potable water in Coconino County is derived from both surface water and groundwater. Surface water to Coconino County users comes from several sources such as the Colorado River, (stored in Lake Powell near Page), small lakes in the Lake Mary area serving the Flagstaff area, and Cataract Creek in Williams. This surface water is a major renewable resource for the county, but can vary dramatically between years, seasons, and locations due to the state's desert climate.

Groundwater is the other primary water source in Coconino County obtained by drilling wells and pumping from large subsurface natural reservoirs known as aquifers. While a significant supply of water remains stored in the aquifers, groundwater has historically been pumped out much more rapidly than it can be replenished through natural recharge, and has lead to a condition known as overdraft. Furthermore, ground water depths on the Colorado Plateau range from 2,000 feet to over a mile deep.

Reclaimed water, or effluent, is another source of water in Coconino County and is the only increasing source of water in the county, although it constitutes only a small amount of the overall water used. As the regional population grows; however, increasing amounts of reclaimed water will be available for agricultural, golf course, and landscape irrigation, as well as industrial cooling, and maintenance of wildlife areas.

Vulnerability – CPRI Results

Гable 4-16: CPRI Rating for Drought										
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score					
Coconino Co.	Highly Likely	Critical	>24 hours	>1 week	3.25					
Flagstaff	Highly Likely	Critical	>24 hours	>1 week	3.25					
Fredonia	Highly Likely	Catastrophic	>24 hours	>1 week	3.55					
Page	Possibly	Limited	>24 hours	>1 week	2.05					
Tusayan	Likely	Critical	>24 hours	>1 week	2.80					
Williams	Likely	Limited	>24 hours	>1 week	2.50					
County-wide average CPRI =										
Note: Maximum CPRI	score is 4.00.									

Vulnerability – Loss Estimations

No standardized methodology exists for estimating losses due to drought and drought does not generally have a direct impact on critical and non-critical facilities and building stock. A direct correlation to loss of human life due to drought is improbable for Coconino County. Instead, drought vulnerability is primarily measured by its potential impact to certain sectors of the County economy and natural resources include the following:

- Crop and livestock agriculture
- Municipal and industrial water supply
- Recreation/tourism
- Wildlife and wildlife habitat



Sustained drought conditions will also have secondary impacts to other hazards such as fissures, flooding, subsidence and wildfire. Extended drought may weaken and dry the grasses, shrubs, and trees of wildfire areas, making them more susceptible to ignition. Drought also tends to reduce the vegetative cover in watersheds, and hence decrease the interception of rainfall and increase the flooding hazard. Subsidence and fissure conditions are aggravated when lean surface water supplies force the pumping of more groundwater to supply the demand without the benefit of recharge from normal rainfall.

From 1995 to 2006, Coconino County farmers and ranchers received \$3.4 million in disaster related assistance funding from the U.S Department of Agriculture (USDA) for crop and livestock damages (EWG, 2009). Over \$1.7 million of those funds were received from 2001 to 2005, which corresponds to the most severe period of the current drought cycle for Coconino County. It is therefore realistic to expect at \$250,000 to \$500,000 in agriculture related drought losses in a given year of severe drought conditions. Other direct costs such as increased pumping costs due to lowering of groundwater levels and costs to expand water infrastructure to compensate for reduced yields or to develop alternative water sources, are a significant factor but very difficult to estimate due to a lack of documentation. There are also the intangible costs associated with lost tourism revenues, and impacts to wildlife habitat and animals. Typically, these impacts are translated into the general economy in the form of higher food and agricultural goods prices and increase utility costs.

Vulnerability - Development Trends

Population growth in Coconino County will also require additional water to meet the thirsty demands of potable, landscape, and industrial uses. It is unlikely that significant growth will occur in the ranching and farming sectors given the current constraints on grazing rights and available range land. Depth to groundwater typically exceeds 1,000 feet, making well installations prohibitively expensive. In some areas, residents share deep wells or form private water companies. Many residents in the rural communities must haul water obtained from municipal standpipes, private water companies, and private wells. Future growth will result in increased demands for existing surface water and groundwater supplies. Drought planning should be a critical component of any domestic water system expansions or land development planning. The ADTF is also working cooperatively with water providers within the State to develop System Water Plans that are comprised of three components:

- *Water Supply Plan* describes the service area, transmission facilities, monthly system production data, historic demand for the past five years, and projected demands for the next five, 10 and 20 years.
- Drought Preparedness Plan includes drought and emergency response strategies, a plan of action to respond to water shortage conditions, and provisions to educate and inform the public.
- Water Conservation Plan addresses measures to control lost and unaccounted for water, considers water rate structures that encourage efficient use of water, and plans for public information and education programs on water conservation.

The combination of these requirements will work to ensure that future development in Coconino County will recognize drought as a potential constraint.

Sources

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AZ Division of Emergency Management, 2009, *State of AZ Hazard Mitigation Plan, 2010*.

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Jacobs, Katharine & Morehouse, Barbara. June 11-13, 2003. "Improved Drought Planning for AZ," from Conference on Water, Climate & Uncertainty: Implications for Western Water Law, Policy & Mgmt http://www.water.az.gov/gdtf/content/files/06262003/Improved Drought Planning for AZ 6-17.pdf

National Integrated Drought Information System, 2007, *National Integrated Drought Information System Implementation Plan*, NOAA.

United States Department of Agriculture http://droughtmonitor.unl.edu



4.5.3 Earthquake

Description

"Arizona lies within and adjacent to seismic zones that have the potential to cause significant damage to critical infrastructure and facilities as well as causing loss of life. As Arizona populations and developed areas grow, so too will the risks posed by earthquake. Earthquakes can occur any time of the year and may result in strong ground motion with a possibility of a ground surface rupture, slope failure (landslide or rockslide), and/or liquefaction. These factors can lead to a particularly destructive effect [to residential, commercial, industrial, and utility structures] from this hazard. Even minor earthquakes can cause critical damage and loss of life" (State of Arizona Hazard Mitigation Plan 2013).

An earthquake is the result of a sudden release of seismic energy during movement of tectonic blocks in the Earth's crust. Seismic wave energy released during an earthquake often causes rapid shaking and ground motion which can cause buildings and bridges to collapse, disrupt gas, electric, and phone service, and sometimes trigger landslides, flash floods and fires. Buildings with foundations resting on unconsolidated landfill, old waterways, and sandy soils with high water tables, or other unstable soil types are most at risk. Buildings or trailers and manufactured homes not tied to a reinforced foundation anchored to the ground are also at risk as they can be shaken off their mountings during an earthquake.

Surface rupture occurs when movement on a fault breaks through to the Earth's surface (Visually, this can be seen as the sides of a fault move in opposing directions at the Earth's surface). Not all earthquakes result in a surface rupture, however when the ground surface is displaced linear type structures such as railways, highways, pipelines, and tunnels built across active surface faults, are susceptible to damage during these occurrences. Ground displacement, or the distance a reference point has moved from its original resting place after an earthquake, for a single earthquake event varies depending on the magnitude, but can be significant (e.g., up to 20 feet in height and up to 200 miles in length along a surface rupture), (State of Arizona Hazard Mitigation Plan 2013).

Liquefaction caused by seismic activity is the process wherein soils transition into a liquid state due to ground shaking from an earthquake. The three primary criteria that must be satisfied for liquefaction to occur are: ground shaking during an earthquake, the presence of sandy soils, and shallow ground water. Structural failures due to liquefaction are due to lateral spread (movement), flow failure, ground oscillation, and/or loss of bearing strength. Liquefaction has occurred in southern Arizona as the result of ground motion from the San Bernardino Valley 1887 earthquake and in western Arizona due to several earthquakes localized in California (DuBois & Smith, 1980; DuBois et al., 1982), (State of Arizona hazard Mitigation Plan 2013).

Earthquakes are commonly described in terms of their Magnitude and Intensity. Magnitude (M) describes the total seismic energy released at the source of the earthquake, and intensity (I) describes the how that energy is received or felt at a particular location. Therefore, an earthquake has one calculated magnitude, but its intensity will vary by distance from the epicenter, type of surface material (e.g., soil, bedrock), and building types. Magnitude is defined by the amplitude (height) of the seismic waves released during an earthquake using a quantitative scale called the Richter scale. "The Richter scale is a logarithmic measurement, where an increase in the scale by one whole number represents a tenfold increase in measured amplitude of the seismic waves (and 32 times more energy). Intensity is defined on a descriptive scale based on how strong the shock was felt at a particular location, and is expressed by the Modified Mercalli Intensity (MMI) scale. Peak ground acceleration (PGA) measures the rate of change of ground motion relative to the rate of acceleration due to gravity. The acceleration due to gravity is often called "g" and is equal to 9.8 meters per second squared (9.80 m/sec2). This means that every second something falls towards earth, its velocity increases by 9.8 meters per second. Accordingly, a PGA of 25%, for example, is equal to a peak ground surface acceleration of 2.44 m/sec2" (State of Arizona Hazard Mitigation Plan 2013). The table below is a comparison of PGA, Magnitude, and Intensity.



Table 4-1	7: Earthqu	ake PGA,	Magnitude & Intensity Comparison
PGA (%g)	Magnitude (Richter)	Intensity (MMI)	Description (MMI)
< 0.17	1.0 - 3.0	I	I. Not felt except by a very few under especially favorable conditions.
0.17 - 1.4	3.0 - 3.9	II - III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
1.4 - 9.2	4.0 - 4.9	IV - V	 IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motorcars rock noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
9.2 - 34	5.0 - 5.9	VI - VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
34 - 124	6.0 - 6.9	VII - IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
>124	7.0 and higher Z State Hazar	X or higher	 X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges destroyed, rails bent greatly. XII. Damage total. Lines of sight & level are distorted. Objects thrown into the air.

Earthquakes generated within Arizona largely occur in the north-central portion of the State. The two largest earthquakes to have been estimated and recorded occurred in southern Arizona ("1887 San Pedro Earthquake", estimated magnitude of 7.2) and north of Flagstaff ("1906-1912 Northern Arizona Earthquakes", recorded magnitude of 6.0-6.2). Numerous faults (depicted as brown lineaments on the forthcoming map) have been identified within Arizona, some of which are known to generate



earthquakes. Active faults known to exist in northern Arizona, California and Mexico have generated large earthquakes that have damaged structures within Arizona's borders. The seismic hazard in Coconino County, particularly the area north of Flagstaff, is considered second in intensity only to that of the Yuma area. Also known as the Northern Arizona Seismic Belt (NASB), this area has a PGA range of 10-30 %g (i.e. VI-VII MMI) and was the source of a number of large (M 6.0 or higher) earthquakes in the early 1900s and numerous smaller earthquakes since then. These events indicate that there is a 50% chance of an M 6.0 or higher earthquake during the next 30 years in the NASB, with the potential of significant damage in the surrounding areas. An M 6.0-7.0 event is considered to be the maximum probable earthquake magnitude for the Flagstaff area (Bausch & Brumbaugh, May 7, 1997), (State of Arizona Hazard Mitigation Plan 2013).

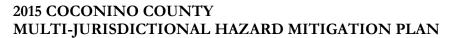
The most prominent earthquake faults in Arizona include the Hurricane fault, Algodones fault, Santa Rita fault, Big Chino fault, Lake Mary fault, and Safford fault. (repository.azgs.az.gov)

History

Earthquakes have occurred in Coconino County history since the early 1900s, but none have resulted in deaths or injuries. The first damaging earthquake known to have occurred within Arizona's borders ruptured on January 25th, 1906 causing a violent shock within Flagstaff. A tremor on August 18, 1912 damaged homes in Williams. In January 1935, an earthquake awakened sleepers at the Grand Canyon causing a distinct subterranean rumble, movement of their homes, and cracked walls. In 1993 another earthquake caused minor damage at the Grand Canyon Village. The Lake Mary Fault, situated immediately south of Flagstaff represents the greatest hazard to the people of Flagstaff and environment according to Dr. David Brumbaugh of the Arizona Earthquake Information Center. In June 2011, the Arizona Integrated Seismic Network detected notable earthquakes in three areas in Coconino Co: near Parks and Tusayan, and just south of Flagstaff (www.homefacts.com/earthquake/arizona/coconino.html).

On November 30, 2014 an earthquake occurred near the Oak Creek fault zone. U.S.G.S. confirmed a 4.7 magnitude on the Richter scale. The epicenter was determined to be "about seven miles north of Sedona, 16 miles south-southwest of Flagstaff and 22 northeast of Cottonwood. It was almost 6.5 miles below the surface of the Earth". (www.homefacts.com/earthquakes/arizona/coconino.html) Or who is this quoted from?) In the early morning hours of October 31, 2009 the 2009 Halloween "earthquake swarm" occurred near Sunset Crater, Arizona, 15 miles northeast of Flagstaff. Approximately 120 small magnitude earthquakes, (M2.0 or smaller), occurred during a six-hour period with the largest being a M2.9 tremor. The swarm occurred in an active volcanic field. (earthquake.usgs.gov/earthquakes/map; Brumbaugh et al. Journal of Volcanology and Geothermal Research). Not all earthquakes are caused by moving tectonic plates. In Northern AZ in particular, many are caused by magma moving through cracks deep in the crust.

Table 4-18:	Table 4-18: Events and Maximum Magnitude for Coconino County									
Year	# of Events	Max Magnitude		Year	# of Events	Max Magnitude				
2013	43	3.05		1996	22	2.7				
2012	41	3.1		1995	22	4.1				
2011	84	3.32		1994	21	3				
2010	14	3.1		1993	152	5.4				
2009	51	3		1992	72	4.5				
2008	1	3.5		1991	8	4				
2007	1	3.2		1990	22	2.9				
2005	41	4.6		1989	181	4				





Source: State I				Total	Average Magnitude
				971	3.27
			1980	7	3.6
1997	78	3.7	1981	1	2
1998	23	4.1	1982	1	3
1999	8	3.4	1983	1	3
2000	14	3.2	1984	1	3
2001	13	2.6	1985	3	2.7
2002	3	3	1986	2	2.6
2003	1	1.3	1987	8	3.3
2004	8	2.8	1988	23	3.1

Source: State Hazard Mitigation Plan 2013

"The USGS database shows there is a 37.18% chance of a major earthquake within 50km of Coconino County, AZ within the next 50 years. The largest earthquake within 30 miles of Coconino County, AZ was a 5.3 Magnitude in 1993". (www.homefacts.com/earthquakes/arizona/coconino.html).

The following Earthquake Epicenters and Faults map shows the known earthquake epicenters and faults for the state. The Earthquake Epicenters and Faults map presents a depiction of documented earthquake epicenters that have occurred within Arizona between 1830 and June 2013. The map depicts the number of events per county and the maximum recorded earthquake magnitude. It also shows identified fault lines (State of Arizona Hazard Mitigation Plan 2013).

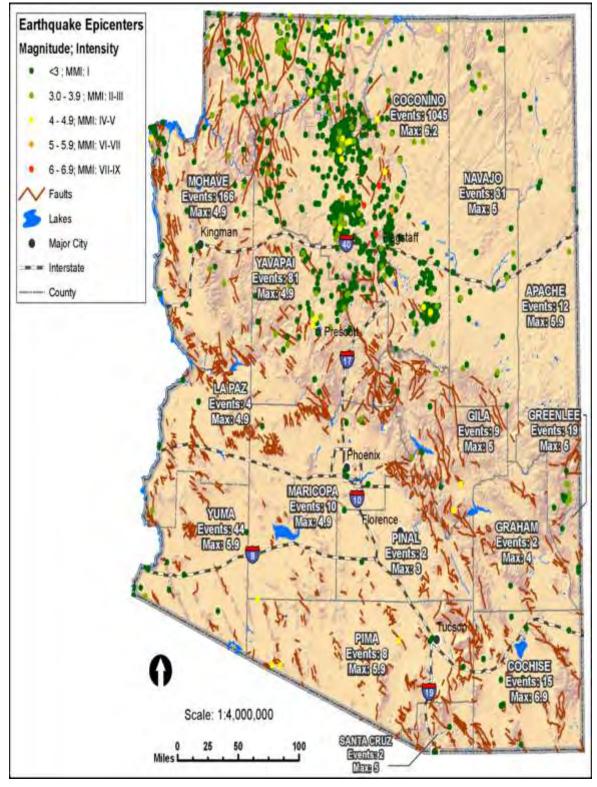
Tourist attractions throughout Coconino County attract large numbers of visitors each year. The availability of mass transportation involving state highways, interstates, rail and air travel facilitate movement of travelers each year through Coconino County and our communities, large and small. The following Mass Transportation map will help the reader visualize the geographical location of Coconino County towns, cities, and some of the smaller populated communities that serve millions of visitors annually.





Map 4-5: Approximate Locations of Historic Earthquakes in or near Arizona

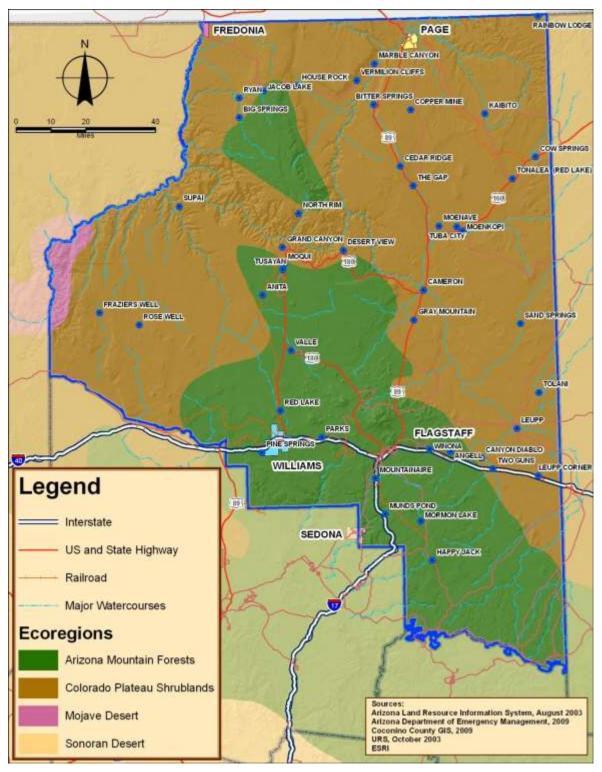




Map 4-6: Earthquake Epicenters and Faults (State of AZ Hazard Mitigation Plan 2013)

Source: USGS - Geologic Hazards Science Center, 2013 - AGIC, 2013- Baker, 2013





Map 4-7: Mass Transportation



Earthquakes could potentially disrupt major transportation routes in Coconino County. These include Interstates 17 and 40, U.S. Highways 160 and 180, State Routes 64, 66, 67, 87, 89, 89A, 98, 99, 260, and 264, and Indian Routes 2, 15 and 18. Burlington-Northern Santa Fe (BNSF) Railway runs through the middle of the county. Hazardous material cargo includes numerous TIER II reportable products and the highly volatile Bakken crude product. The AMTRAK passenger trains also operate on the BNSF lines with depots located in Flagstaff and Williams. Air traffic in Flagstaff, Grand Canyon National Park, Williams, Page, Tuba City and Valle could also be impacted.

Utility disruption due to earthquakes is a potential risk as well. Arizona Public Service (APS) is the predominant provider of electricity to the County except on the Navajo Nation which has its own electricity supplier, Navajo Tribal Utility Authority. Natural gas and propane disruption to cities and areas throughout the County could be a possibility.

Loss of water and sewer service is another possibility. Most incorporated areas within the County have their own water system and waste water or sewer system. Water for the City of Flagstaff comes from over 40 wells, surface water stored in Lake Mary, and a spring from the Inner Basin in the San Francisco Peaks. The City of Williams water supply comes from wells or lakes and reservoirs. After treatment, water is distributed to storage tanks and then gravity fed to customers. Page receives all of their water from Lake Powell. After being treated at their city plant, it is distributed directly to their customers. Outside of these areas, residents receive their water piped from private water companies, hire commercial water haulers, or haul the water themselves. Personally owned wells do exist in many parts of the county but many residents rely on hauled water. Although the incorporated areas may have waste water systems, most residents outside the cities have septic systems for sewer.

Secondary or Cascading Effects

These are events that can occur as a result of the earthquake and can continually build upon the challenges Emergency Management, First Responders, etc. face when dealing with the effects of an earthquake. The type or range of cascading events are largely determined by the magnitude and location of the event, and various other factors including proximity to the epicenter, nature of the substrate (soil type, solid rock, unconsolidated sediments, saturated sediments), building style (e.g., unreinforced masonry buildings vs. reinforced masonry or wood frame buildings), age and type of structures, time of day, and bodies of water. Building materials and construction standards play a significant role in the extent of earthquake damage. Additional cascading events may include ruptured gas and water lines, and collapsed bridges along the previously mentioned transportation routes. Breached dams, landslides, rock falls and communications failures are also possibilities.

Vulnerability - CPRI Results

Table 4-19: CPRI Rating for Earthquake										
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score					
Coconino Co.	Likely	Limited	<6 hours	<6 hours	2.65					
Flagstaff	Likely	Limited	<6 hours	<6 hours	2.65					
Fredonia	Possibly	Negligible	<6 hours	<6 hours	1.90					
Page	Possibly	Limited	<6 hours	>1 week	2.50					
Tusayan	Likely	Critical	<6 hours	<6 hours	2.95					
Williams	Possibly	Limited	<6 hours	<6 hours	2.20					
County-wide average CPRI =										





Table 4-19: CPRI Rating for Earthquake										
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score					
Note: Maximum CPRI	Note: Maximum CPRI score is 4.00.									



4.5.4 Flood

Description

For the purpose of this Plan, the hazard of flooding addressed in this section will pertain to floods that result from precipitation/runoff related events. Other flooding due to dam failures is addressed separately. The three seasonal atmospheric events that tend to trigger floods in Coconino County are:

- Tropical Storm Remnants: Some of the worst flooding tends to occur when the remnants of a hurricane that has been downgraded to a tropical storm or tropical depression enter the State. These events occur infrequently and mostly in the early autumn, and usually bring heavy and intense precipitation over large regions causing severe flooding.
- Winter Rains: Winter brings the threat of low intensity; but long duration rains covering large areas that cause extensive flooding and erosion, particularly when combined with snowmelt. In particular rain-on-snow events can be devastating due to the rapid snowmelt and frozen ground conditions that lead to increased run-off and flooding.
- Summer Monsoons: A third atmospheric condition that brings flooding to Arizona is the annual summer monsoon. In mid to late summer the southerly monsoon circulation brings humid subtropical air into the State. Solar heating triggers afternoon and evening thunderstorms that can produce extremely intense, short duration bursts of rainfall. The thunderstorm rains are mostly translated into runoff and in some instances, the accumulation of runoff occurs very quickly resulting in a rapidly moving flood wave referred to as a flash flood. Flash floods tend to be very localized and cause significant flooding of local watercourses.

Damaging floods in the County can be primarily categorized as either riverine or local area flows. Riverine flooding occurs along established watercourses when the bank full capacity of a wash is exceeded by storm runoff or snowmelt and the overbank areas become inundated. Local area flooding is often the result of poorly designed or planned development wherein natural flow paths are altered, blocked or obliterated, and localized ponding and conveyance problems result. Erosion is also often associated with damages due to flooding.

Warmer ocean and atmosphere temperatures over the past 20 years have led to an increase in atmospheric moisture available for precipitation, resulting in some heavier rain- and snowfall events than the average in northern Arizona. Recent years have had fewer cold winter storms, resulting in warmer winter conditions. Warmer temperatures can lead to fewer winter snow events, and more winter rain events, but more importantly for flooding, more rain-on-snow events. So far, the climate division record for Coconino, Navajo and Apache Counties shows significant warming in the most recent 20 years. But there is no clear trend in the frequency of extreme precipitation events, though the record shows extreme annual variability.

Precipitation during the monsoon season can be particularly heavy for short durations, and when these heavy rains fall on burn areas the flash flooding includes large debris flows. The warmer eastern Pacific Ocean waters also increase the potential for eastern Pacific hurricane formation off the coast of central America and Mexico, which bring additional moisture to the monsoon events in August and September, even if the tropical storms dissipate before reaching Arizona. Three tropical storms in late summer of 2014 reached Arizona causing significant flooding statewide, including Coconino County.

History

Coconino County has been part of 10 presidential disaster declarations for flooding, making it clearly a major hazard for the area. The following incidents represent examples of major flooding that has impacted the County:



- February-March 2015, Oak Creek rose above all low water crossings for several days (February 28 thru March 3) due to heavy rains in the area and upstream. This is a normal event but one of significance when considering the potential for post fire flooding as a result of the Slide Fire.
- July 2014, the event of July 8 was one of the largest urban flood events ever recorded for the City of Flagstaff. The storm event that led to flooding was a very rare event. Estimates indicate that the storm event was one that would be expected to occur once every 100 years (1% chance of occurring in any given year) and possibly only once every 500 years (.2% chance of occurring in any given year) based on an approximately 100 year climate record. Several residential structures were evacuated during debris removal and cleanup. (Utilities Division Stormwater Management Fact Sheet www.flastaffwatershedprotection.org).
- 2013, record monsoon activity contributed to flooding incidents in Kaibab Estates West, McCann
 Estates in the Doney Park area, and Havasupai Village. Some homes in McCann estates sustained
 significant damage. It is important to note this particular flooding of McCann estates was
 unrelated to the Schultz Burn impacts but was the result of three significant rainfalls on the
 watershed areas above McCann Estates. The water treatment facility in Havasupai was
 temporarily disabled and potable water and sandbags were flown in by helicopter.
- 2011-2014, additional post fire flooding related to the Schultz Burn. These flood events contributed to property damage, debris flows, and damage to utilities, roads and some structures. There was no loss of homes.
- July 2010, heavy rain from thunderstorms over the Schultz Burn area of the San Francisco Peaks near Flagstaff Arizona caused severe post fire flooding and loss of a child's life in the residential areas inclusive of Doney Park, and Timberline-Fernwood. The aftermath of the largest wild land fire in Arizona in 2010 and subsequent "sediment and ash-laden floods caused extensive damage to homes, property, and infrastructure up to 4 miles from the burn". The Schultz Fire caused significant impact to portions of several watersheds. (Field Trip Guide to the 2010 Schultz Burn Area Arizona Hydrological Society Annual symposium 2011)
- August 2008, heavy rain from thunderstorms over the Cataract Creek and Havasu Creek drainages caused flash flooding that started in the Village of Supai around 11:30 PM on August 16. Radar estimated between three to four inches of rain over several square miles in the Cataract Creek drainage during the afternoon. Additional heavy rain from thunderstorms on August 17 contributed heavy runoff into the canyon. Cataract Canyon/Creek becomes Havasu Canyon/Creek at Havasu Springs about a mile upstream from the Village of Supai. The flooding lasted several days and caused damage to a few homes in the Village of Supai. There was extensive damage to Havasu Canyon and the campground below the village. Many campers were stranded during the night in trees and on picnic tables. In all, 406 people were flown out of Havasu Canyon by helicopters. This very popular destination for tourists was closed for at least 6 months because of the heavy damage caused by the flash flooding (NCDC, 2008).
- December 2004, a strong Pacific storm system moved across Arizona December 28th and 29th with heavy rainfall. The governor declared a state of emergency for Coconino and Yavapai Counties which provided \$200,000 aid for relief efforts. The heavy rain and melting snow resulted in excessive runoff in many areas from Williams to Flagstaff to Winslow and south to Prescott and Black Canyon City. High water, mudslides, and rock slides resulted in numerous road closures and evacuations in the area. Many creeks experienced significant rises. Some storm total rainfall amounts were: Flagstaff 3.83 inches, Crown King 4.73 inches, Sedona 4.06 inches, Winslow 0.54 inches, Payson 2.88 inches. Flagstaff received its second largest calendar day precipitation on record. Seventy people were evacuated in southwest Flagstaff when water overtopped an earthen flood control dam. A 14 mile section of Highway 89 between Flagstaff and



Sedona was closed because of rock slides. Preliminary counts indicate that as many as 150 homes may have sustained damages up to approximately one million dollars. Roads and bridges sustained an additional \$1M damage (NCDC, 2008).

- September 1997, repeat thunderstorms over the Grand Canyon National Park produced some the worst flash flooding seen in years. Severe damage was done to the Bright Angel and North Kaibab hiking trails, forcing their closure for nearly two weeks. Flood waters also undermined a major water supply line to the South Rim. Conservative damage and repair amounts were estimated at \$2.5 million. The injuries included one broken leg, and three with lacerations. In addition 26 campers were airlifted out of the canyon due to the trail washouts (NCDC, 2008).
- August 1997, a flash flood on Phantom Creek killed two people and injured a third person. Runoff from the heavy rain associated with a thunderstorm several miles north of the flash flood site caught the three people as they were crossing Phantom Creek. All three attempted to save themselves by crouching behind a large boulder, but chest-deep water carried them downstream. The bodies of the two who were killed were found several weeks later, miles downstream in the Colorado River. The survivor was carried one quarter mile down Phantom Creek then another quarter mile down Bright Angel Creek before he was able to escape and hike out of the canyon (NCDC, 2008).
- August 1996, eleven hikers and tourists were drowned by a flash flood in Antelope Canyon, a narrow slot canyon five miles southeast of Page. A severe thunderstorm three to five miles upstream produced very heavy rain causing a wall of water to crash down Antelope Canyon. In the area of the flood fatalities the depth and width of Antelope Canyon varies from about 20 feet across and 30 feet deep to points where it is 200 feet deep but only two (2) feet across. A camera recovered after the event reveals a 50 to 80 foot wall of water swept through the canyon. It is a popular site for hiking and photography where access is via rope ladders controlled by Navajo Nation representatives. The eleven who died as well as the tour guide were warned not to enter the canyon because of the flood potential from an approaching thunderstorm. The tour guide alone survived after being carried several miles downstream by the flood (NCDC, 2008).
- January-February 1993, heavy rain fell over most of north, central and southeastern Arizona resulting in significant flooding along most major watercourses. In Coconino County, considerable damages were experienced in a few problem areas, with most damages occurring to structures built prior to the county's enactment of floodplain ordinances. According to the USACE Flood Damages Report¹³, Coconino County had in excess of \$5.5 million in public and private losses due to flooding damages. The flooding prompted a federal disaster declaration for almost the entire state (NCDC, 2008).

¹³ US Army Corps of Engineers, Los Angeles District, 1994, Flood Damage Report - State of Arizona - Floods of 1993



Photos from Schultz Post-Fire Flooding















Probability and Magnitude

For the purposes of this Plan, the probability and magnitude of flood hazards in Coconino County jurisdictions are based on the 1% probability floodplains delineated on FEMA Flood Insurance Rate Maps (FIRMs), plus any provisional floodplain delineations used for in-house purposes by participating jurisdictions. FEMA has recently completed a map modification program to update the FIRMs for the County into a digital FIRM (DFIRM) format. As of April 2009, the maps are in draft form and have not been formally approved by the County. Significant reductions to the floodplain limits of more than one floodplain in the Flagstaff area are anticipated by the County. The revisions are scheduled for completion next year and the County expects the maps will be made effective in September 2010. The April 2009 draft DFIRM floodplain GIS base files were provided by the Coconino County Engineering Division and are the basis for the flood hazard depictions in this Plan. Therefore, the vulnerability analysis results in this plan are likely conservative.

Two designations of flood hazard are used, with HIGH hazard areas being any "A" zone and MEDIUM flood hazard being either all "Shaded X" zones. All "A" zones (e.g. – A, A1-99, AE, AH, AO, etc.) represent areas with a one percent (1%) probability of being flooded at a depth of one-foot or greater in any given year. All "Shaded X" zones represent areas with a 0.2% probability of being flooded at a depth of one-foot or greater in any given year. These two storms are often referred to as the 100-year and 500-year storm, respectively.



Vulnerability - CPRI Results

Table 4-20: CPRI	Rating for Flood	ling						
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score			
Coconino Co.	Highly Likely	Critical	<6 hours	<24 hours	3.50			
Flagstaff	Highly Likely	Critical	<6 hours	<1 week	3.60			
Fredonia	Highly Likely	Critical	<6 hours	<6 hours	3.40			
Page	Possibly	Limited	<6 hours	<6 hours	2.20			
Tusayan	Likely	Critical	<6 hours	<24 hours	3.05			
Williams	Likely	Limited	<6 hours	<6 hours	2.65			
County-wide average CPRI =								
Note: Maximum CPRI	Note: Maximum CPRI score is 4.00.							

Vulnerability – Loss Estimations

The estimation of potential exposure to high and medium flood hazards was accomplished by intersecting the human and facility assets with the flood hazard limits depicted on the maps that follow. Loss estimates to all facilities located within the high and medium flood hazard areas were made based on the loss estimation tables published by FEMA (FEMA, 2001). Most of the assets located within high hazard flood areas will be subject to three feet or less of flooding. Using the FEMA tables, it is assumed that all structural assets located within the high hazard areas will have a loss-to-exposure ratio of 0.20 (or 20%). A loss to exposure ratio of 0.05 (5%) is assumed for assets located in the medium hazard areas. Estimated exposure and losses to population and structures are provided below.

Table 4-21: Estimated Asset Exposure to High & Medium Hazard Flooding								
Community	Total Facilities Reported by Community	Impacted Facilities	Percentage of Total Community Facilities Impacted	Estimated Replacement Cost (x \$1000)	Estimated Structure Loss (x \$1000)			
HIGH								
County-Wide Totals	497	38	7.65%	\$22,569	\$4,514			
Unincorporated Coconino Co	162	10	6.17%	\$7,905	\$1,581			
Flagstaff	219	20	9.13%	\$13,164	\$2,633			
Page	60	1	1.67%	\$1,500	\$300			
Williams	56	7	12.50%	\$0	\$0			
		MEDIUN	1					
County-Wide Totals	497	44	8.85%	\$26,335	\$1,317			
Unincorporated Coconino Co	162	10	6.17%	\$7,424	\$371			
Flagstaff	219	15	6.85%	\$6,506	\$325			
Page	60	0	0.00%	\$0	\$0			
Williams	56	19	33.93%	\$12,405	\$620			





Table 4-22: Estimated Pop	Table 4-22: Estimated Population Exposed to High and Medium Hazard Flooding							
Community	Total Population	Population Exposed	Percent of Population Exposed	Total Popul ation Over 65	Population Over 65 Exposed	Percent of Population Over 65 Exposed		
	HIGH							
County-Wide Totals	139,881	7,925	5.67%	8,906	349	3.92%		
Flagstaff	65,478	6,497	9.92%	3,347	204	6.09%		
Page	7,283	4	0.05%	393	0	0.00%		
Unincorporated Coconino Co	30,941	709	2.29%	1,994	42	2.09%		
Williams	3,326	494	14.84%	356	48	13.48%		
		MEDIUN	M					
County-Wide Totals	139,881	6,872	4.91%	8,906	512	5.75%		
Flagstaff	65,478	5,435	8.30%	3,347	346	10.34%		
Page	7,283	0	0.00%	393	0	0.00%		
Unincorporated Coconino Co	30,941	127	0.41%	1,994	10	0.49%		
Williams	3,326	963	28.95%	356	116	32.68%		





Table 4-23: Coconino Co Estimated Building Exposure to Flooding									
	Res	Residential		Commercial		lustrial	Summary		
Coconino Co HAZUS	Building	Potential Economic Impact	Building	Potential Economic Impact	Building	Potential Economic Impact	Total of All Economic Impact	Loss-to- Exposure	Total Estimated Loss
Summary	Count	(x\$1000)	Count	(x\$1000)	Count	(x\$1000)	(x\$1000)	Ratio	(x\$1000)
County-Wide Totals	50,471	\$8,932,983	2,384	\$2,500,987	611	\$389,374	\$11,823,344		
High Hazard Exposure	2,261	\$568,594	197	\$227,509	38	\$29,814	\$825,917	20%	\$165,183
Medium Hazard Exposure	2,017	\$386,559	216	\$207,407	52	\$27,989	\$621,955	5%	\$31,098
	%	% Potential	%	% Potential	%	% Potential			
Coconino Co HAZUS	Building	Economic	Building	Economic	Building	Economic			
Summary	Count	Impact	Count	Impact	Count	Impact			
High Hazard Exposure	4.48%	6.37%	8.27%	9.10%	6.14%	7.66%			
Medium Hazard Exposure	4.0%	4.33%	9.04%	8.29%	8.50%	7.19%			

Table 4-24: Flagstaff Estimated Building Exposure to Flooding									
	Res	idential	Con	Commercial		lustrial	Summary		
Flagstaff (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)
Community-Wide Totals	16,521	\$3,918,391	1,320	\$1,485,011	322	\$232,205	\$5,635,607	Itatio	(A\$1000)
High Hazard Exposure	1,268	\$405,414	141	\$170,640	26	\$24,614	\$600,668	20%	\$120,134
Medium Hazard Exposure	1,372	\$293,623	171	\$180,059	43	\$24,014	\$497,697	5%	\$24,885
Flagstaff (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact			
High Hazard Exposure	7.67%	10.35%	10.72%	11.49%	8.03%	10.60%			
Medium Hazard Exposure	8.30%	7.49%	12.98%	12.13%	13.34%	10.34%			



0.0%

0.0%

0.0%

Medium Hazard Exposure



0.0%

Table 4-25: Page Estimated Building Exposure to Flooding									
	Res	Residential		Commercial		lustrial	Summary		
Page (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)
Community-Wide Totals	2,568	\$383,986	80	\$65,815	13	\$3,671	\$453,473		
High Hazard Exposure	1	\$887	0	\$1,215	0	\$10	\$2,112	20%	\$422
Medium Hazard Exposure	0	\$0	0	\$0	0	\$0	\$0	5%	\$0
D (G 1 G)	%	% Potential	%	% Potential	%	% Potential			
Page (Coconino Co)	Building	Economic	Building	Economic	Building	Economic			
HAZUS Summary	Count	Impact	Count	Impact	Count	Impact			
High Hazard Exposure	0.05%	0.23%	0.42%	1.85%	0.26%	0.27%			

0.0%

0.0%

Table 4-26: Williams Estimated Building Exposure to Flooding									
	Res	idential	Con	Commercial		lustrial	Summary		
Williams (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)
Community-Wide Totals	1,469	\$200,380	113	\$69,440	13	\$4,985	\$274,805		
High Hazard Exposure	185	\$25,108	13	\$6,069	1	\$104	\$31,281	20%	\$6,256
Medium Hazard Exposure	385	\$56,005	36	\$20,605	6	\$1,771	\$78,380	5%	\$3,919
Williams (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact			
High Hazard Exposure	12.58%	12.53%	11.33%	8.74%	6.05%	2.08%			
Medium Hazard Exposure	26.18%	27.95%	31.57%	29.67%	49.23%	35.52%			



Table 4-27: Unincorporated Coconino Co Estimated Building Exposure to Flooding									
	Res	Residential		Commercial		lustrial	Summary		
Unincorporated (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)
Community-Wide Totals	18,435	\$2,935,368	583	\$445,427	205	\$107,147	\$3,487,942		
High Hazard Exposure	660	\$103,111	30	\$31,323	8	\$4,010	\$138,444	20%	\$27,689
Medium Hazard Exposure	92	\$15,481	5	\$2,987	2	\$788	\$19,255	5%	\$963
Unincorporated (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact			
High Hazard Exposure	3.58%	3.51%	5.20%	7.03%	3.76%	3.74%			
Medium Hazard Exposure	0.50%	0.53%	0.81%	0.67%	0.84%	0.74%			



In summary, \$4.5 million and \$1.3 million in asset related losses are estimated for high and medium flood hazards, for all the participating jurisdictions in Coconino County. An additional \$165 and \$31 million in high and medium flood losses to HAZUS defined residential, commercial, and industrial facilities is estimated for all participating Coconino County jurisdictions. Regarding human vulnerability, a total population of 7,925 people, or 5.67% of the total 2009 Coconino County projected population, is potentially exposed to a high hazard flood event. A total population of 6,872 people, or 4.91% of the total population, is potentially exposed to a medium hazard flood event. Based on the historic record, multiple deaths and injuries are plausible and a substantial portion of the exposed population is subject to displacement depending on the event magnitude.

It is duly noted that the loss and exposure numbers presented above represent a comprehensive evaluation of the County as a whole. It is unlikely that a storm event would occur that would flood all of the delineated high and medium flood hazard areas at the same time. Accordingly, actual event based losses and exposure are likely to be only a fraction of those summarized above. Furthermore, it should be noted that a flood event that exposes any assets or population to the MEDIUM hazard would also expose assets and populations to the HIGH hazard flood zone. That is, the 100-year floodplain would be entirely inundated during a 500-year flood.

Vulnerability – Repetitive Loss Properties

Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties are those NFIP-insured properties that since 1978, have experienced multiple flood losses. FEMA tracks RL properties to identify Severe RL (SRL) properties. RL properties demonstrate a track record of repeated flooding for a certain location and are one element of the vulnerability analysis. RL properties are also important to the NFIP, since structures that flood frequently put a strain on the National Flood Insurance Fund. According to FEMA, as of February 2015, there are 10 RL properties in the County and as of January 2015, one SRL property. Due to these properties, there has been a total of over \$500,000 in associated building and contents value payments.

Table 4-28: Repetitive Flood Loss Properties in Coconino County						
Jurisdiction	No. of Properties	RL	SRL			
Munds Park	1	0	1			
Flagstaff	1	1	0			
Sedona	9	9	0			
Source	e: FEMA, 2015					

National Flood Insurance Program Participation

Participation in the NFIP is a key element of any community's local floodplain management and flood mitigation strategy. Coconino County and three of the four incorporated jurisdictions participate in the NFIP. Joining the NFIP requires the adoption of a floodplain management ordinance that requires jurisdictions to follow established minimum standards set forth by FEMA and the State of Arizona, when developing in the floodplain. These standards require that all new buildings and substantial improvements to existing buildings will be protected from damage by the 100-year flood, and that new floodplain development will not aggravate existing flood problems or increase damage to other properties. As a participant in the NFIP, communities also benefit from having Flood Insurance Rate Maps (FIRM) that



map identified flood hazard areas and can be used to assess flood hazard risk, regulate construction practices and set flood insurance rates. FIRMs are also an important source of information to educate residents, government officials and the private sector about the likelihood of flooding in their community. The table below summarizes the NFIP status and statistics for each of the jurisdictions participating in this Plan.

Jurisdiction	Comm ID	NFIP Entry Date	Effective Map Date (DFIRM)	# of Policies	Total Amount of Coverage	Floodplain Management Role
Coconino Co	040019	11/16/1983	09/03/2010	819	\$218,320,700	Provides floodplain management for the Unincorporated County. Participant of the Coconino Co Flood Control District.
Flagstaff	040020	1/19/1983	09/03/2010	477	\$119,287,000	Provides in-house floodplain management. Participant of the Coconino Co Flood Control District.
Fredonia	040021	05/17/1982	09/03/2010	4	\$1,260,000	Provides in-house floodplain management. Participant of the Coconino Co Flood Control District.
Page	040113	07/11/2011	09/03/2010	5	\$1,700,000	Provides in-house floodplain management. Participant of the Coconino Co Flood Control District.
Tusayan			1	No informat	ion available.	
Williams	040027	12/15/1983	09/03/2010	32	\$9,358,900	Provides in-house floodplain management. Participant of the Coconino Co Flood Control District.

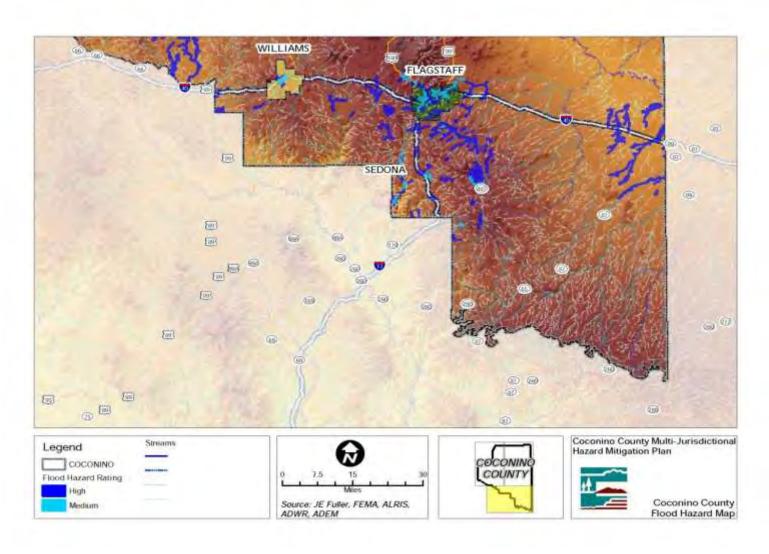
http://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13

Community Rating System

The Community Rating System (CRS) is a voluntary program for NFIP participating communities. The goals of the CRS are to reduce flood damages to insurable property, strengthen and support the insurance aspects of the NFIP, and encourage a comprehensive approach to floodplain management. The CRS has been developed to provide incentives in the form of premium discounts for communities to go beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding.

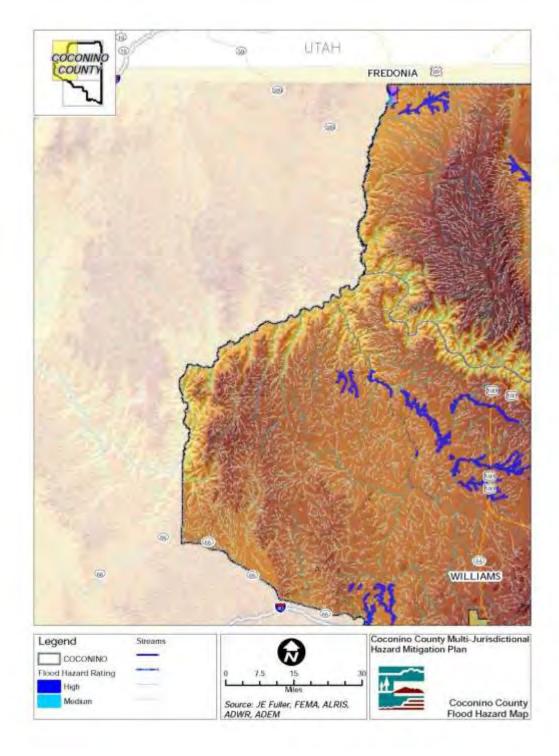
There are 10 CRS classes; Class 1 provides the most credit points and gives the greatest premium discount; Class 10 identifies a community that does not apply for the CRS, or does not obtain a minimum number of credit points and receives no discount. Activities recognized as measures for eliminating exposure to floods and worth CRS points are organized under four main categories: Public Information, Mapping and Regulation, Flood Damage Reduction, and Flood Preparedness, Currently, only Coconino County and Flagstaff participate in the CRS program and their class ratings are 8 and 5, respectively.





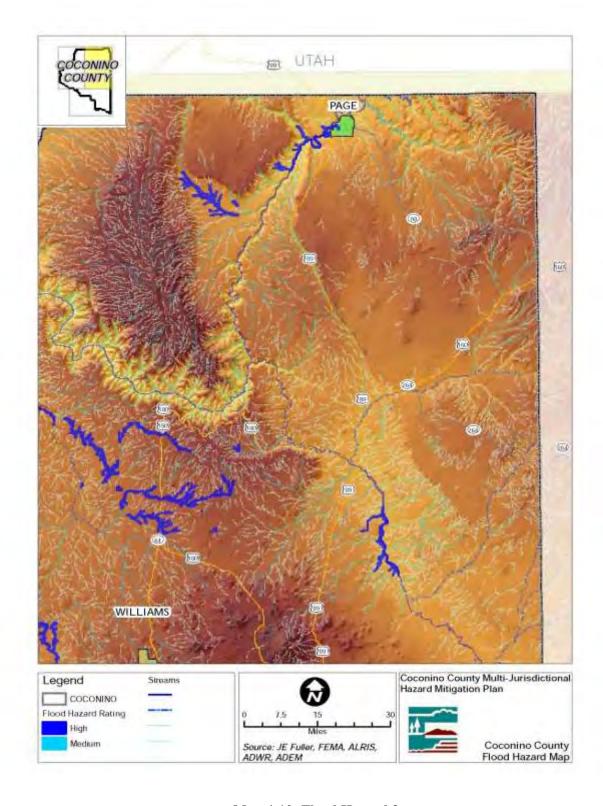
Map 4-8: Flood Hazard 1





Map 4-9: Flood Hazard 2





Map 4-10: Flood Hazard 3



Sources

AZ Division of Emergency Management, 2009, State of AZ Multi-Hazard Mitigation Plan, 2010.

FEMA, 2001, Understanding Your Risks; Identifying Hazards and Estimating Losses, FEMA Document No. 386-2.

U.S. Dept of Commerce, National Climatic Data Center, 2008, Storm Events Database, accessed via the following URL: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

U.S. Army Corps of Engineers, Los Angeles District, 1978, Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Coconino County, Arizona, FCDMC Library #802.024.

U.S. Army Corps of Engineers, Los Angeles District, 1994, Flood Damage Report, State of AZ, Floods of 1993.



4.5.5 Hazardous Materials Incidents

Description

The threat of exposure to Hazardous Materials (HazMat) in our modern society is prevalent nationwide and throughout Coconino County. HazMat incidents can occur from either point source spills or from transportation related accidents. In Coconino County, the primary areas of risk associated with HazMat incidents are located near or along storage / manufacturing facilities, major roads and rail lines, and pipelines that transport hazardous substances. These substances may be highly toxic, reactive, corrosive, flammable, explosive, radioactive or infectious, with potential to contaminate air, soil, and water resources and pose a serious risk to life, health, environment and property. HazMat incidents can result in the evacuation of a few people, a specific facility, or an entire neighborhood(s) depending on the size and magnitude of the release and environmental conditions.

The Arizona State Emergency Response Commission (AZSERC), established by Arizona Law (Arizona Revised Statutes-Title 26, Chapter 2, Article 3) is tasked with the implementation of the Emergency Planning and Community Right to Know Act (EPCRA) in Arizona. Local Emergency Planning Committees (LEPC) are appointed by AZSERC, as required by EPCRA, first to design, then to regularly review and update a comprehensive emergency plan for an emergency planning district. There are 15 LEPC's in Arizona - one in each county.

State statutes and Sections 311 and 312 of EPCRA set forth hazardous chemical storage reporting requirements and thresholds for facilities possessing hazardous materials. The legislation requires that facilities storing or producing hazardous materials in quantities that exceed a defined Threshold Planning Quantity (TPQ), submit an annual chemical inventory report (Tier II Hazardous Chemical Inventory Form) to AZSERC, the appropriate LEPC, and local fire department, by March 1 of each year. Facilities holding an Extremely Hazardous Substance (EHS) at quantities exceeding the Threshold Planning Quantities (TPQ) must provide the notifications as well as a representative to participate in the county emergency planning process. For the purposes of this Plan, the Planning Team chose to focus only on those HazMat facilities and chemicals that are classified by the Environmental Protection Agency (EPA) as extremely hazardous substances (EHS) Typical EHS materials transported and stored routinely in the county include chlorine gas, sulphuric acid, and hydrogen flouride.

History

According to the National Response Commission database, there are at least 10 reported incidents of HazMat releases that have occurred since 2009 within Coconino County that involved at least one injury/fatality or some amount of property damage. Many of the incidents were tied to vehicular accidents involving passenger vehicles, semi-tractor trailers, and/or railroad cars.

The following incidents represent examples of hazardous materials incidents that have occurred in Coconino County:

- June of 2005, an MC-306 (Gasoline Highway cargo tank) overturned on Hwy 160 near Moenkopi, AZ. (just East of Tuba City). An initial assessment of the cargo tank confirmed it was leaking from at least one compartment. The ruptured container leaked 1200 Gallons of gasoline into a nearby stream had leaked from one compartment and the team off loaded the others.
- Fall 2000, two westbound freight trains collided two miles east of Bellemont, causing a derailment. Three rail crew employees were injured and one was missing. The missing crewman was found dead in the wreckage a couple days later. A large fire involving diesel fuel from the three locomotives caused 15 nearby residences to be evacuated. I-40 was also closed for several hours due to heavy smoke from the fires.
- March 1988, two eastbound freight trains collided near the 2100 block of East Santa Fe Avenue in Flagstaff. Three people injured and 20 freight cars derailed, as well as five locomotives. The



diesel fuel from the engines ignited requiring hundreds of gallons of Class B foam to extinguish the fires. 200 residents, mostly from nearby businesses had to be evacuated.

Probability and Magnitude

There are no known probability statistics regarding HazMat incidents for Coconino County. Typically, the magnitude of impact from a HazMat incident can be projected by using models such as ALOHA and CAMEO with assumed incident characteristics such as chemical type and source amount, spill location and amount, release time and rate, surface type, temperature, humidity, wind direction and speed, chemical stability factors. Those modeling efforts, however, are beyond the scope of this Plan.

A review of the State of Arizona Tier Two Chemical Inventory Reporting shows the following:

(County Wide)

Organizations with reportable quantities: 72

Number of physical addresses with reportable quantities: 187

(numerous addresses have reportable quantities of more than one chemical)

Reportable quantities county wide (all chemical reports): 393

Reportable quantities within municipal jurisdictions: 216 of 393 locations (54.96%)

Reportable quantities in un-incorporated areas: 177 of 393 locations (45%)

Extremely Hazardous Substance (EHS) reports: 75 of 393 (19%)

Ranked in order of highest to lowest number of reports (county-wide):

Sulfuric Acid: 53

Chlorine: 7

Lead: 5

Cyclohexylamine: 4

Ammonia: 2 Isopropanol: 1

Magnesium Nitrate: 1

Satellite Supermax Toilet Deodorizer: 1

Sulphur Dioxide: 1

The largest concentration of extremely hazardous substances appears to be in Flagstaff, followed by the un-incorporated areas, then Page and finally Williams.



Vulnerability – CPRI Results

Table 4-30: CPR	Rating for Haza	rdous Materia	als Incidents				
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score		
Coconino	Likely	Limited	<6 hours	<6 hours	2.65		
Flagstaff	Likely	Limited	<6 hours	<24 hours	2.75		
Fredonia	Possibly	Limited	<6 hours	<6 hours	2.20		
Page	Highly Likely	Critical	<6 hours	<6 hours	3.40		
Tusayan	Possibly	Critical	<6 hours	<1 week	2.70		
Williams	Likely	Limited	<6 hours	<24 hours	2.75		
County-wide average CPRI =							
Note: Maximum CPR	Note: Maximum CPRI score is 4.00.						



4.5.6 Severe Wind

Description

The hazard of severe wind encompasses all climatic events that produce damaging winds. For Coconino County, severe winds usually result from either extreme pressure gradients that usually occur in the spring and early summer months, or from thunderstorms. Thunderstorms can occur year-round and are usually associated with cold fronts in the winter, monsoon activity in the summer, and tropical storms in the late summer or early fall.

Three types of damaging wind related features typically accompany a thunderstorm; 1) downbursts, 2) straight line winds, and infrequently, 3) tornadoes.

Downbursts are columns of air moving rapidly downward through a thunderstorm. When the air reaches the ground, it spreads out in all directions, creating horizontal wind gusts of 80 mph or higher. Downburst winds have been measured as high as 140 mph. Some of the air curls back upward with the potential to generate a new thunderstorm cell. Downbursts are called macrobursts when the diameter is greater than 2.5 miles, and microbursts when the diameter is 2.5 miles or less. They can be either dry or wet downbursts, where the wet downburst contains precipitation that continues all the way down to the ground, while the precipitation in a dry downburst evaporates on the way to the ground, decreasing the air temperature and increasing the air speed. In a microburst the wind speeds are highest near the location where the downdraft reached the surface, and are reduced as they move outward due to the friction of objects at the surface. Typical damage from downbursts includes uprooted trees, downed power lines, mobile homes knocked off their foundations, block walls and fences blown down, and porches and awnings blown off homes.

Straight line winds are developed similar to downbursts, but are usually sustained for greater periods as a thunderstorms reaches the mature stage, traveling parallel to the ground surface at speeds of 75 mph or higher. These winds are frequently responsible for generating dust storms and sand storms, reducing visibility and creating hazardous driving conditions.

A tornado is a rapidly rotating funnel (or vortex) of air that extends toward the ground from a cumulonimbus cloud. Most funnel clouds do not touch the ground, but when the lower tip of the funnel cloud touches the earth, it becomes a tornado and can cause extensive damage. For Coconino County, tornadoes are the least common severe wind to accompany a thunderstorm.

Warming temperatures across the southwest are not expected to change the severe wind climatology. The current regime of severe winds, primarily from thunderstorms, should not change in the future as there is no evidence of an increase of pressure gradients or other forcing factors. The downbursts from summer thunderstorms will continue to be the primary source, but there is no evidence to indicate an increase in frequency or intensity. There is no evidence of a trend of increased in the frequency or severity of tornados in the state, though there were 8 tornados on October 6, 2010, with the strongest being an EF3.

History

Prior to 2010 Coconino County had been subject to over 24 severe wind events with a combined loss of over \$146,000 to structures and agriculture, two deaths, and 30 injuries in the last 50 years. Historically Coconino County experiences severe wind events more than 24 times *per year*. *Up* to 80 thunderstorms occur in Coconino County every year on average (ADEM, 2004). The following are examples of significant documented past events:

October 6, 2010, eleven tornados touched down in the County. Of the 11 tornados, two were EF-3, four were EF-2, two were EF-1, and three were EF-0. (Source NWS Flagstaff Office). 101 homes suffered various levels of damage. The area of Bellemont Arizona was the hardest hit. The Flagstaff Meadows subdivision had three homes completely destroyed, nine homes with major



damage, and fifteen homes experienced minor damage. I- 40 and the Burlington Northern Santa Fe (BNSF) rail line run east and west parallel and next to the Flagstaff Meadows housing area. Several vehicles along the I 40 corridor were flipped over, and Burlington Northern Santa Fe railroad experienced a 20 rail car derailment.

- April 2010, strong winds and blowing dust have closed stretch the stretch of Interstate 40 between Meteor Crater rest area and Winslow twice this month for several hours. Blowing dust had reduced visibility so much so that the Arizona Department of Transportation closed the 17-mile stretch of interstate. Strong, gusting sustained southwest winds of 30 to 40 mph, with gusts of 45 to 55 mph were predicted. (Source Arizona Daily Sun April 12th, 2010).
- September 2000, a strong dust devil at the Coconino County Fairgrounds caused property damage and personal injuries. The dust devil ripped shingles off two roofs, blew down four large tents, blew over a ticket booth and split the supporting beams on a permanent structure. Two people sustained minor scrapes and bruises and one person reported a back injury (NCDC, 2008).
- June 1995, very strong north to northeast winds caused significant damage and combined with cold temperatures to produce extremely cold wind chills above 9,000 feet in the San Francisco Peaks area north of Flagstaff. The highest wind gust of 90 kt (105 mph) was recorded by the Arizona Snowbowl ski area at 0300 MST at an elevation of 10,800 feet. Winds blew down approximately 80 trees in the Arizona Snowbowl. One fallen tree caused several thousand dollars damage to a ski lift. Communication lines and power were down also for several hours on the morning of the 18th (NCDC, 2008).

Additional areas of notable historic impact include the Glen Canyon Recreation Area/Lake Powell, where severe wind events transform the lake's water surface into dangerous waves that have proven to be fatal and extremely damaging to the surrounding marinas.

Pictures of the Bellemont Tornadoes, October 2010













Probability and Magnitude

Most severe wind events are associated with thunderstorms as previously mentioned. The probability of a severe thunderstorm occurring with high velocity winds increases as the average duration and number of thunderstorm events increases. The duration of thunderstorms in Coconino County is among the longest in the nation. An area stretching northwest from Flagstaff to the junction of the Arizona, Utah, and Nevada borders have an average annual thunderstorm duration of 110-130 minutes. The minimum average duration time for thunderstorms in Arizona is 70 minutes, although individual storm cells may last less than 30 minutes before a new cell propagates. Lightning strikes are another indicator of thunderstorm hazard. Coconino County has 14-16 lightning strikes per square kilometer annually (ADEM, 2009).

The NWS issues a severe thunderstorm watch when conditions are favorable for the development of severe thunderstorms. The local NWS office considers a thunderstorm severe if it produces hail at least 3/4-inch in diameter, wind of 58 mph or higher, or tornadoes. When a watch is issued for a region, residents are encouraged to continue normal activities but should remain alert for signs of approaching



storms, and continue to listen for weather forecasts and statements from the local NWS office. When a severe thunderstorm has been detected by weather radar or one has been reported by trained storm spotters, the local NWS office will issue a severe thunderstorm warning. A severe thunderstorm warning is an urgent message to the affected counties that a severe thunderstorm is imminent. The warning time provided by a severe thunderstorm watch may be on the order of hours, while a severe thunderstorm warning typically provides an hour or less warning time.

The probability of tornadoes occurring is much less frequent than thunderstorms. The NCDC reports only 27 tornadoes between 1950 and 2009, which averages to less than one tornado every two years. Reported damages associated with those tornadoes only add up to \$40,000 or less than \$2,000 per event (NCDC, 2008).

Tornado damage severity is measured by the Fujita Tornado Scale, which assigns a numerical value of 0 to 5 based on wind speeds, as shown in Table 5-28, with the letter F preceding the number (e.g., FO, F1, F2). Most tornadoes last less than 30 minutes, but some last for over an hour. The path of a tornado can range from a few hundred feet to miles. The width of a tornado may range from tens of yards to more than a quarter of a mile.

Table 4-31	: Fujita Torn	ado Scale
Category	Wind Gust (MPH)	Description of Damage
EF-0	65-85	Minor damage. Shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled
EF-1	86-110	Moderate damage. More significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.
EF-2	111-135	Considerable damage. Roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.
EF-3	136-165	Severe damage. Entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.
EF-4	207-260	Extreme damage. Well-constructed homes are leveled; cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.
EF-5	166-200	Massive/Incredible damage. Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.
Source: NO	AA.gov 2007	

Vulnerability - CPRI Results

Table 4-32: CPRI Rating for Severe Wind							
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score		
Coconino	Likely	Limited	6-12 hours	<24 hours	2.60		
Flagstaff	Possibly	Limited	6-12 hours	<6 hours	2.05		
Fredonia	Possibly	Limited	12-24 hours	<24 hours	2.00		



Table 4-32: CPRI Rating for Severe Wind							
Jurisdiction	Probability	Magnitude/ Severity	y ai ning		CPRI Score		
Page	Likely	Critical	6-12 hours	<6 hours	2.80		
Tusayan	Possibly	Limited	12-24 hours	<1 week	2.10		
Williams	Possibly	Limited	12-24 hours	<24 hours	2.00		
County-wide average CPRI =							
Note: Maximum CPR	score is 4.00.						

Vulnerability – Loss Estimations

The entire County is assumed to be equally exposed to the damage risks associated with the severe winds. Typically, incidents are fairly localized and damages associated with individual events are relatively small. Based on the limited historic record over the last 50 years, it is difficult to estimate annual monetary losses as a result of severe winds. However, the historic record indicates some fatalities and injuries have resulted from severe wind related events, therefore, it is feasible to assume that deaths and/or injuries are plausible.

Sources

Arizona Division of Emergency Management, 2004, State of Arizona All Hazard Mitigation Plan.

Arizona Division of Emergency Management, 2009, State of AZ Hazard Mitigation Plan, 2010.

U.S. Dept of Commerce, National Climatic Data Center, 2008, Storm Events Database, accessed via the following URL: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms



4.5.6 Transportation Accidents

Description

Coconino County is home to several major transportation elements. Interstate 40 is a major trucking route that nearly spans the entire U.S. from east to west. Interstate 17 connects Interstates 40 and 10 and is the primary truck route south into Phoenix. Highways 89 and 89A are the primary connectors between Sedona, Flagstaff, Page and Fredonia. Highway 180 and State Route 64 serve to provide access to the south rim of the Grand Canyon and. Highway 160 serves as the primary artery across the Navajo and Hopi Nations to the Four Corners area. There are also hundreds of miles of other state and county roadways that comprise the county's transportation infrastructure. The Burlington-Northern Santa Fe (BNSF) Railway extends east-west through the southern portion of the county and passes directly through the hearts of Flagstaff and Williams. AMTRAK also operates on the BNSF lines and maintains passenger depots in Flagstaff and Williams. The City of Flagstaff operates Flagstaff-Pulliam Airport, which is the largest commercial airport in the County. Grand Canyon National Park Airport is located in Tusayan. Smaller, public-use airports are located in Tuba City, Williams, and Valle, and there are several other private airstrips scattered across the County. The combined impact of all the air, roadway, and railway traffic presents an appreciable hazard potential to the urbanized areas of the County.

History

In the past, Coconino County residents have been exposed to several train derailments, train/vehicle and train/pedestrian accidents, multiple car accidents due to winter storms and icy roadways, and airplane crashes. In most cases, the actual property damages at an incident level are limited to the vehicles involved. The greatest losses are manifested in fatalities and injuries. Associated consequences may include hazardous material releases, emergency response capacity limitations, freeway/highway closures, and wildfire ignition. Given the size of the County, many of the rural and isolated portions of these transportation corridors are difficult to provide emergency services to and can often severely tax a community's emergency operational budget and capacity.

Coconino County has been subject to over 38 major transportation accidents with a combined loss of over \$6,456,000, 80 deaths, and 60 injuries in the last 50 years. The Planning Team recognizes that traffic accidents occur almost every day and that the table below under represents the true historic account of transportation accidents in the County. The following are examples of documented past transportation accidents:

- 2015, a BNSF train derailed, approximately 6 miles northwest of Williams. One of the engines and two-three cars ran off the rails and remained upright. There were no injuries and no hazardous materials release. There was no impact to roads or surrounding infrastructure.
- June 2014, a single engine Cessna fixed-wing airplane landed in the backyard of a Page residence. One pilot and two passengers all self extricated. All three were assessed and transported to Page ER.
- May 2014, an American Aviation Cessna tour plane was found overturned. It appeared that the
 aircraft had been attempting to land and impacted short of the runway. One pilot and six
 passengers were on board. All were treated on scene and transported to Page ER. Incident
 resulted in one fatality.
- June 2008, two medical helicopters with patients aboard crashed upon approach to Flagstaff Medical Center starting a 20 acre wildfire. There were seven fatalities and property damage was estimated at \$6,000,000 (Flagstaff Fire Department 2009).
- October 2000, a westbound Burlington Northern Santa Fe train collided into a second westbound train that was stopped. The collision resulted in a diesel fuel fire, forcing the closure of I-40, and



evacuation of approximately 20 residential structures. The collision resulted in the death of one BNSF employee and three others injured.

- 1991, an Air Grand Canyon passenger plane crash, with seven fatalities in the Grand Canyon (http://ntsb.gov).
- March 1988, two Santa Fe Railway trains carrying produce derailed in Flagstaff. Five locomotives went off the tracks and burst into flames. An evacuation of the surrounding area was initiated. Three injuries were reported (City of Flagstaff, 2004).
- June 1986, a Grand Canyon Airlines plane collided with a sightseeing helicopter inside the canyon killing 25 People (ADEM 2008).

According to the most recent I-40 Corridor Hazardous Materials¹⁴ study, daily traffic counts on I-40 in Coconino County range from 12,000 to as high as 20,000 vehicles per day in Flagstaff. Approximately 91 trains per day pass through Williams, traveling along the BNSF Rail Line. According to the study, there were 11 incidents reported by the National Response Center along I-40 in Arizona between 1991 and 2004 involving the release of hazardous materials, three of which were in or near Flagstaff. There were six railway incidents involving the release of hazardous materials within the same time period, three of which were in Flagstaff. ADEQ reported 33 hazardous material incidents within Coconino County along highway or railroad corridors between June 1986 and November 2001 according to the I-40 Corridor study. More information on hazardous materials incidents can be found in the Hazardous Materials Incidents profile in this section.

Probability and Magnitude

In many instances, transportation accidents are often caused by a combination of weather related events such as high winds, dust/sand storms, rain, snow, or ice and the corresponding human reactions to them. In Coconino County, the two primary categories of accident potential are either ground based or air based. Ground based incidents include roadway and railway accidents. Air based incidents involve the failure of aircraft during take-off, flight, and/or landing sequences. For both types of incidents, it is reasonable to project that the entire County and community assets and population are potentially exposed to an accident in one form or another, and especially along road, rail and airport corridors.

High risk vehicular corridors include Interstates 17 and 40, Highways 89, 89A, 160, 180, and State Routes 64, 67, 87, 98, 99, and 264. The higher speeds and greater numbers of vehicles along these corridors combine to create an increased risk for major accidents, and especially around town and city population centers. The table below is an excerpt from vehicular crash statistics for Coconino published by the Motor Vehicle Division of the Arizona Department of Transportation¹⁵. It is interesting to note that the most number of crashes resulting in fatalities occur on State and other rural roads. This is likely due to the higher rates of speed and increased potential for multiple vehicle accidents.

¹⁴ AMEC Earth & Environmental, Inc., Hazardous Materials Commodity Flow Study Report I-40 Corridor, Arterial Highways and Railway, September 16, 2004

¹⁵ ADOT, MVD, 2008, Arizona Motor Vehicle Crash Facts 2008



Table 4-33: Crash Statistics for Coconino County for 2013								
	Number of Crashes			Number of Persons		Alcohol Related		
	Total	Fatal	Injury	Killed	Injured	Crashes	Killed	Injured
Coconino Co	1,252	31	356	33	555	63	8	63
Flagstaff	1,856	6	388	6	531	62	4	44
Fredonia	0	0	0	0	0	0	0	0
Williams	96	0	16	0	222	3	0	0
Page	120	0	34	0	55	10	0	2
Sedona	223	1	65	1	87	9	1	5
Tusayan	Not available							
Source: ADOT Annual Crash Statistics Report 2013								

High risk railway corridors are generally the areas where railroads pass through the more densely populated towns and cities. Incidents typically involve either vehicular or pedestrian contact with moving trains and are often fatal to those struck by the train. There are a number of reported vehicle/train and pedestrian/train incidents resulting in a fatalities and it is realistic to expect that future fatalities will occur. Other hazards were typically associated with railway accidents include hazardous material spills and ignition of wildfires.

The highest risk areas associated with aviation corridors are the areas typically identified as runway protection zones (RPZ). These trapezoidal areas extend from either end of the runway for a sufficient distance to allow safe take-off and landing approach angles. They are also the areas with the highest risk of aircraft accidents outside of the runway itself.

Vulnerability – CPRI Results

Table 4-34: CPRI Rating for Transportation Accidents								
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score			
Coconino Co	Highly Likely	Critical	<6 hours	<6 hours	3.40			
Flagstaff	Highly Likely	Critical	<6 hours	<24 hours	3.50			
Fredonia	Likely	Limited	<6 hours	<6 hours	2.65			
Page	Highly Likely	Critical	<6 hours	<6 hours	3.40			
Tusayan	Likely	Critical	<6 hours	<6 hours	2.95			
Williams	Highly Likely	Limited	<6 hours	<24 hours	3.20			
County-wide average CPRI =								
Note: Maximum CPRI score is 4.00.								



Vulnerability – Loss Estimations

Potential losses and damages due to major transportation accidents are difficult to estimate without extensive research, compilation, and statistical analysis of often hard to obtain data. No such studies currently exist for Coconino County, therefore, no detailed estimates of potential human and property losses and damages will be made. The primary transportation corridors across the entire County are assumed to be equally exposed to the damage risks associated with Transportation Accidents. Typically, incidents are fairly localized and damages associated with individual events are limited to the accident site itself. Based on the limited monetary historic record over the last 50 years, it is difficult to estimate annual monetary losses associated with Transportation Accidents. However, the historic record indicates a high number of fatalities and injuries have occurred, therefore, it is feasible to assume that multiple deaths and/or injuries are plausible in any given year.

Sources

Arizona Division of Emergency Management, 2004, State of Arizona All Hazard Mitigation Plan.

AZ Division of Emergency Management, 2009, State of AZ Hazard Mitigation Plan, 2010 Update.

City of Flagstaff, 2004, Historic data provided for the 2005 Coconino County Hazard Mitigation Plan.

Flagstaff Fire Dept, 2009, Historic data provided by the Flagstaff Fire Dept (Planning Team) in 2009.

U.S. Dept. of Commerce, National Climatic Data Center, 2008, Storm Events Database, accessed via: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms



4.5.7 Wildfire

Description

A wildfire is an uncontrolled fire spreading through wild land vegetative fuels and/or urban interface areas where fuels may include structures. They often begin unnoticed, spread quickly, and may be signaled by dense smoke that may fill the area for miles around. Wildfires can be human-caused through acts such as arson or campfires, or can be caused by natural events such as lightning. If not promptly controlled, wildfires may grow into an emergency or disaster. Even small fires can threaten lives, resources, and destroy improved properties.

The indirect effects of wildfires can also be catastrophic. In addition to stripping the land of vegetation and destroying forest resources and personal property, large, intense fires can harm the soil, waterways and the land itself. Soil exposed to intense heat may temporarily lose its capability to absorb moisture and support life. Exposed soils in denuded watersheds erode quickly and are easily transported to rivers and streams thereby enhancing flood potential, harming aquatic life and degrading water quality. Lands stripped of vegetation are also subject to increased landslide hazards.

The Community Wildfire Protection Plan for Flagstaff and Surrounding Communities¹⁶ (Flagstaff CWPP), Greater Williams Area Community Wildfire Protection Plan¹⁷ (Williams CWPP), and Tusayan Community Wildfire Protection Plan¹⁸ (Tusayan CWPP) are three community wildfire protection plans that cover various urbanized areas of Coconino County. Another Community Wildfire Protection Plan¹⁹ is currently underway that covers the Blue Ridge Fire District (CWPPBR).

The Greater Flagstaff Forests Partnership (GFFP) and Ponderosa Fire Advisory Council (PFAC) combined forces to prepare the Flagstaff CWPP, and it is the largest planning area of the three plans, covering a significant portion of the forested areas within the vicinity of Flagstaff and Sedona. In the pages that follow, there is an excerpt from each of the community wildfire protection plans showing the limits of the study area and the extent of communities identified to be within wild land/urban interface areas.

To the extent that wildfires are a cascading effect of drought or warmer temperatures, the wildfire risk will likely increase somewhat in the future. This assumes the current drought will continue, since the dryness and stress from drought is cumulative. However, the extreme variability of precipitation across the southwest, combined with the trend for increasing temperatures, may lead to extremely dry conditions within the forest and grasslands of Coconino County even in the absence of a prolonged drought.

History

The mountainous regions of Coconino County offer significant sources of fuel and topography favorable to wildfire. The intersection of environmental and economic sectors versus historically natural fire patterns and seasons, has left much of the forested areas in a prime condition to experience extremely destructive fires. In addition, compounded hazards such as bark beetle infestations as a result of extended severe drought conditions only exasperate the wildfire hazard. According to the Planning Team, wildfire

¹⁶ GFFP and PFAC, January 2005, Community Wildfire Protection Plan for Flagstaff and Surrounding Communities in the Coconino and Kaibab National Forests of Coconino County, Arizona

¹⁷ Kleindienst, George, March 2005, Greater Williams Area Community Wildfire Protection Plan

¹⁸ Tusayan Community Wildfire Protection Committee, February 2005, Tusayan Community Wildfire Protection Plan an At-Risk Community of the Kaibab National Forest in Coconino County

¹⁹ Wildwood Consulting, July 2009, DRAFT – Community Wildfire Protection Plan Blue Ridge Area and Mogollon Rim Ranger District of the Coconino National Forest



is the number one hazard in Coconino County. Numerous wildfires have impacted the County as demonstrated by the following recent events:

- May 20, 2014, the Slide Fire was a human caused fire that scorched 21,227 acres in Oak Creek Canyon north of Sedona, Arizona. Approximately 100 homes were evacuated, and Highway 89 A was closed from Pine Flats campground north to the Overlook at the top of the switchbacks. Fire suppression costs are listed at \$10.1 million (inciweb.nwcg.gov/incident/article/3874/22003). Post fire flooding in Oak Creek Canyon was immediately recognized as a great potential. The Oak Creek Canyon Interagency Emergency Operations Flood Plan was produced at a cost of \$42,000.00 to aid responding emergency resources to an Oak Creek Canyon (Post Slide Fire) Flood Event.
- June 20, 2010, the Schultz Fire ignited from an abandoned campfire near Schultz Tank and Elden Trail and consumed 15,000 acres of the San Francisco Peaks. This fire was driven by high winds across the steep terrain of the eastern slope. The fire caused the evacuation of more than 1000 residents and was contained on June 30. Post fire flooding from heavy rains from the 4th wettest monsoon on record in Flagstaff resulted in numerous debris flows, significant erosion, and substantial flooding of the residential areas on both sides of Highway 89 North inclusive of Timberline-Fernwood and traveling north past Wupatki Trails subdivision. (Field Trip Guide to the 2010 Schultz Fire Burn Area 2011).
- June 19, 2010, the Hardy Fire was ignited by a camper dumping hot ashes and embers from a camp stove onto the ground. The resulting fire burned 3026 acres southeast of downtown Flagstaff. Over 200 homes and the Coconino Humane Association animal shelter had to be evacuated. There were no injuries and no structure damage.
- June 11, 2010, the Eagle Rock Fire on the Kaibab National Forest began approximately 11 miles northwest of Williams, Arizona. The presumed lightning caused fire consumed 3, 400 acres and caused the evacuation of several residents.
- July 6, 2007, the Birdie Fire near Mormon Lake was lightning caused and burned approximately 5018 acres, no structure loss or damage.
- June 2006, the Brins Fire ignited in the Coconino National Forest near the communities of Sedona and Oak Creek Canyon burning 4,317 acres. Most of Oak Creek Canyon was evacuated; fire suppression resources responded from federal, state and local governments. The situation necessitated the activation of the AZ211 call center and the Governor declared an emergency on June 19, 2006. The Brins Fire started within 3 miles of Sedona on June 18th from an abandoned campfire. The fire was located in the rugged terrain to the west of Oak creek Canyon and north of the town of Sedona. The close proximity to these communities created a serious threat to hundreds of residents, homes and businesses. The previous winter had been extremely dry with little or no snow at the higher elevations. The effects of the drought, coupled with the rugged and broken topography within the vicinity of the fire, made for difficult suppression. This was a serious threat to hundreds of homes and structures and infrastructures valued at well over eightfive million dollars, not to mention Sedona and Oak Creek Canyon as a worldwide tourist attraction. Oak Creek Canyon was evacuated and remained closed to residents, businesses and visitors for 6 days. The urban interface was the priority for fire suppression and structure protection activities. Suppression costs were estimated at \$6.4 million (Coconino County, 2009).
- June 2006, the Woody Fire started from sparks of a blown tire along Interstate 40. The Woody Fire burned approximately 110 acres in West Flagstaff and threatened multiple neighborhoods. Hundreds of people were evacuated and some were placed in community shelters (Flagstaff Fire Dept. & Coconino Co., 2009).



- June 2002, the Rodeo-Chediski fire burned 468,640 acres and destroyed more than 450 houses in Navajo, Apache, Coconino and Gila counties and the Fort Apache Indian Reservation, triggering a State and Federal Disaster Declaration. Disaster aid to Arizona in the wake of the massive Rodeo-Chediski fire has topped \$26 million. The total cost of the fire damage was estimated at over \$34 million (ADEM, 2009).
- April 2000, the Outlet Fire on the North Rim burned more than 14,000 acres. It started as a 1,500-acre prescribed burn then spread east, jumped AZ 87 and burned parts of Point Imperial and Cape Royal Scenic Drive. The prescribed fire was designed to help rejuvenate forested areas and prevent future wildfires. The fire resulted in closures of part of the Point Imperial Park on the North Rim for weeks (National Park Service, 2008).

Photos from Slide Fire











Declared disaster and historic hazard data collected may not adequately reflect the true cost of a wildfire, particularly, the cost of wildfire suppression efforts to prevent structure and human loss. For example, damage estimates for the Woody and Brins fires was estimated at \$10,000 and \$0, respectively. However, the suppression costs for the Woody and Brins fires are estimated at \$157,000 and \$6.4 million, respectively. Furthermore, the County, State, Forest Service, and other agencies spend millions of dollars every year in wildfire mitigation in fuel treatment projects.

The study completed by the Alliance Bank Business Outreach Center at Northern Arizona University W.A. Franke College of Business estimates the impact of the Schultz Fire and post fire flooding at approximately \$133 million and \$147 million. Factors taken into account for this study include loss in personal wealth due to reduced property values, official expenditures of government agencies and utilities, habitat destruction, loss of life, structural damage, cleanup, unpaid labor, armoring against flooding, cost of fire evacuation, and flood insurance premiums (A Full Cost Accounting of the 2010 Schultz Fire, Alliance Bank Business Outreach Center at Northern Arizona University W.A. Franke College of Business, May 2013).

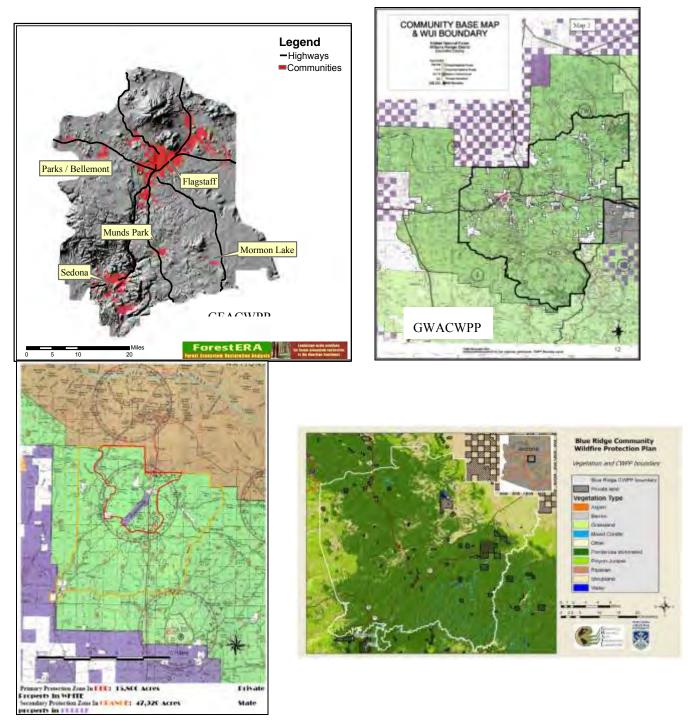
The Arizona State Forestry Division has previously collected the majority of recent wildfire fuel treatment projects for the Greater Flagstaff Forest Partnership (GFFP). The geographical extents of each treatment project collected were compiled on a map for the purpose of identifying future fuel treatment needs. There exist a multitude of fire agencies and resources including the efforts of Coconino County with the Rural Communities Fuel Management Partnership that continue to conduct mitigation fuel treatments in coordination with the Arizona State Forestry Division to protect our communities at risk in



Coconino County. However, due to the long term and ongoing budget constraints, the recording of the ongoing fuel treatment areas for map purposes (FIREMAP) has fallen behind and is no longer in use. Therefore the maps you see in this profile are not current for all treatments conducted over the past three years since 2012. Those maps still offer value to help identify communities at risk and for now will remain in this update.

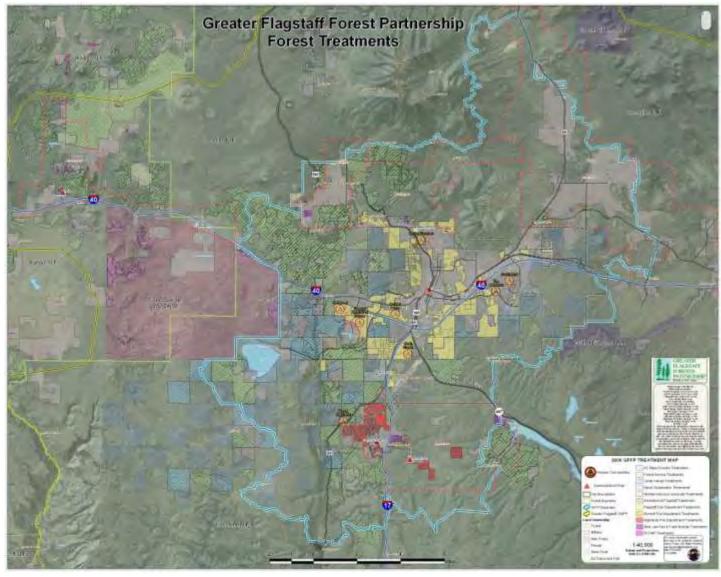
The Arizona State Forestry Division is making great progress to meet their goal of communities at risk identification and further communication efforts with all stake holders. A new website: the Arizona Wildfire Risk Assessment Portal (WRAP) will enable wildfire professionals and the general public to assess wildfire risk information in their areas. This online risk assessment portal is based on the wide risk assessment data and analysis completed in 2013. More importantly, Arizona WRAP will assist fire professionals to clearly define communities at risk and prioritize management activities based on that risk.





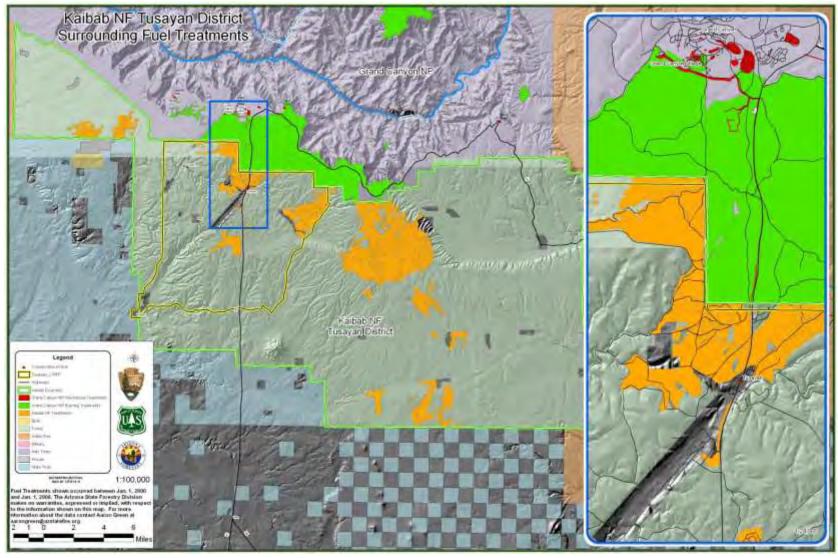
Map 4-11: Limits of Various Community Wildfire Protection Plan Study Areas





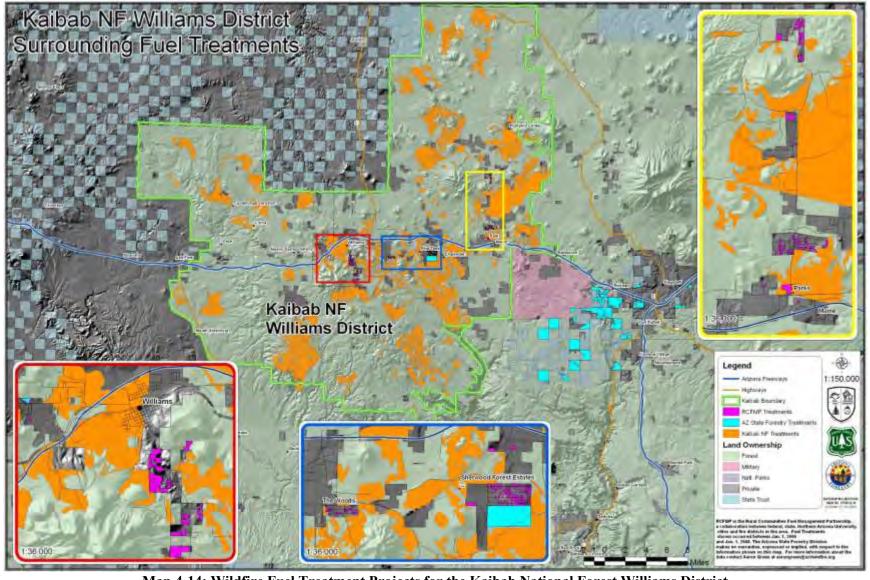
Map 4-12: Wildfire Fuel Treatment Projects for the Greater Flagstaff Forest Partnership





Map 4-13: Wildfire Fuel Treatment Projects for the Kaibab National Forest Tusayan District





Map 4-14: Wildfire Fuel Treatment Projects for the Kaibab National Forest Williams District



Probability and Magnitude

The probability and magnitude of wildfire incidents for Coconino Co are influenced by numerous factors including vegetation densities, previous burn history, hydrologic conditions, climatic conditions such as temperature, humidity, and wind, ignition source (human or natural), topographic aspect and slope, and remoteness of area.

Wildfire hazard areas have been identified by the State of Arizona as a part of the 2003/04 Arizona Wild land Urban Interface Assessment (AWUIA) project (Fisher, 2004). The increasing growth of Arizona's rural populations, urban sprawl, and increasing wild land fuel loads ads to create a mix of situations that is known as the wild land urban interface (WUI). The purpose of the AWUIA was to attempt to conduct an analysis on a statewide basis using a common spatial model, for validation of those communities listed in the federal register as WUI, and further identify possible other communities at risk. The AWUIA approach used four main data layers:

- TOPO aspect and slope derived from 30 meter Digital Elevation Model data from USGS.
- RISK historical fire density using point data from fire record years 1986–1996 from all wild land agencies.
- HAZARD fuels, natural fire regimes and condition class.
- HOUSE houses and/or structures

A value rating of 1-15 was used for all layers.

Two separate results were developed. The first coverage used an applied weighting scheme that combined each of the four data layers to develop a ranking model for identifying WUI communities at greatest risk. The second coverage, referred to as the "Land Hazard", also applied a weighting scheme that combined only the TOPO, RISK, and HAZARD layers, as follows:

LAND HAZARD = (HAZARD*70%)+(RISK*20%)+(TOPO*10%)

Weighing percentages were determined through discussion with the Arizona Interagency Coordinating Group. The "Land Hazard" layer produced from this model is based on a 250-meter raster grid (some data originated at 1,000-meter). The resultant raster values range from 1-15 and were classified into three groups to depict wildfire hazard without the influence of structures: high (values of 10-15), medium (values of 7-9), and low (values of 1-6). The AWUIA identified 24 WUI communities as at a high or moderate risk in Coconino County as shown below.

Table 4-35: WUI Community Risk as of 2004						
High Risk	Moderate Risk					
Bellemont	Bitter Springs					
Flagstaff	Desert View					
Forest Lakes	Fredonia					
Grand Canyon Village	LeChee					
Jacob Lake	Navajo Mountain					
Mormon Lake	Page					
Mountainaire	Parks					
Munds Park	Red Lake					

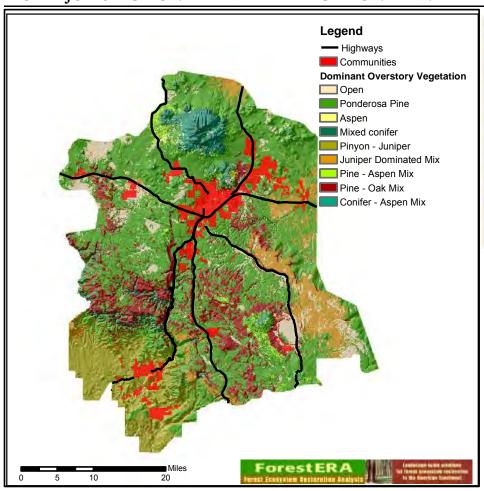




North Rim	Sedona
Oak Creek Canyon	Tuba City
Supai	Valle
Tusayan	Williams
Source: AWUIA, 2004	

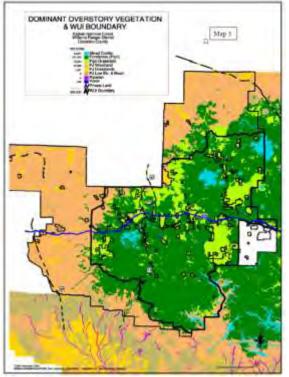
The maps below are from the Flagstaff CWPP, Williams CWPP, and Blue Ridge CWPP (draft) presenting vegetation types within the study limits of those plans. There was no map available in the Tusayan CWPP for display.





Map 4-15: Dominant Vegetation Types w/i Various CWPP Study Areas







NOTE OF IMPORTANCE:

The information in the remaining sections has not been updated since the development of the 2010 Plan. The only changes that have occurred since the completion of the 2010 Plan is the follow through with fuel treatments to further protect the identified communities at risk, and the future implementation of Arizona WRAP mentioned earlier.

A detailed wildfire hazard map was developed during the preparation of the Williams CWPP and depicts the risk of a crown fire. This hazard layer was developed using the INFORMS computer program. This risk map was used in lieu of AWUIA wildfire hazard layer within the extents of the study as this risk map is considered the best available information. The crown fire risk map from the Williams CWPP contains four hazard categories; Low, Moderate, High, and Extreme. For the purpose of this planning effort, the Planning Team agreed to consider Extreme and High one in the same and merged into the High category.

A detailed threat index was calculated for the Flagstaff CWPP study area by Forest ERA²⁰; however, the source GIS data was not available to include in the wildfire hazard layer for this plan. The Flagstaff Fire Department maintains a wildfire threat analysis within the City limits. The data used to analyze the threat includes accessibility to fire trucks, fire hydrant coverage, ponderosa pine locations, encumbrances, slope, fuel treatment areas, roof types, and structure proximity. This threat analysis map was also used in lieu of AWUIA wildfire hazard layer within the extents of the City of Flagstaff. The analysis results contain four hazard categories; Low, Moderate, High, and Extreme. For the purpose of this planning effort, the Planning Team agreed to consider Extreme and High one in the same and merged into the High category.

No maps or wildfire threat analysis results were available for the Tusayan or Blue Ridge CWPPs at the time of this planning effort. The resulting wildfire hazard areas presented on the following maps are a combination of the state-wide hazard coverage prepared by AWUIA, the Williams CWPP, and the Flagstaff Fire Department threat map. This composite wildfire hazard layer will be used quantitatively for the vulnerability assessment.

Vulnerability - CPRI Results

Table 4-36: CPRI	Table 4-36: CPRI Rating for Wildfire											
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score							
Coconino	Highly Likely	Catastrophic	6-12 hours	>1 week	3.85							
Flagstaff	Highly Likely	Catastrophic	<6 hours	<1 week	3.90							
Fredonia	Unlikely	Negligible	<6 hours	<6 hours	1.45							
Page	Unlikely	Negligible	<6 hours	<6 hours	1.45							
Tusayan	Highly Likely	Catastrophic	6-12 hours	>1 week	3.85							
Williams	Highly Likely	Critical	< 6 hours	>1 week	3.70							
County-wide average CPRI =												
Note: Maximum CPRI s	core is 4.00.											

²⁰ Forest Ecosystem Restoration Analysis, Northern Arizona University Center for Environmental Sciences and Education, http://www.forestera.nau.edu/



Vulnerability – Loss Estimations

The estimation of potential exposure to high and medium wildfire hazards was accomplished by intersecting the human and facility assets with the wildfire hazard limits depicted on the flowing hazard maps. Loss to exposure ratios of 0.20 (20%) and 0.05 (5%) were assumed to estimate losses for all facilities located within the high and medium wildfire hazard areas, respectively. The table below summarizes the Planning Team identified critical and non-critical facilities potentially exposed to high and medium wildfire hazards, and the corresponding estimates of losses.

In summary, \$9.6 million and \$2.0 million in asset related losses are estimated for high and medium wildfire hazards, for all the participating jurisdictions in Coconino County. An additional \$704 and \$102 million in high and medium hazard wildfire losses to HAZUS defined residential, commercial, and industrial facilities, is estimated for all participating Coconino County jurisdictions. It should be noted that these exposure dollar amounts do not include the cost of wildfire suppression which can be substantial. For example, a Type 1 wildfire fighter crew costs about \$1 million per day.

Table 4-37: Estimated Asset Exposure to High & Medium Wildfire Hazard												
Community	Total Facilities Reported	Impacted Facilities	Percentage of Total Community Facilities Impacted	Estimated Replacement Cost (x \$1000)	Estimated Structure Loss (x \$1000)							
HIGH												
County-Wide Totals	497	126	25.35%	\$47,997	\$9,599							
Unincorporated Coconino Co	162	53	32.72%	\$11,970	\$2,394							
Flagstaff	219	72	32.88%	\$36,027	\$7,205							
Page	60	0	0.00%	\$0	\$0							
Williams	56	1	1.79%	\$0	\$0							
		MEDIUM										
County-Wide Totals	497	71	14.29%	\$40,298	\$2,015							
Unincorporated Coconino County	162	38	23.46%	\$7,900	\$395							
Flagstaff	219	31	14.16%	\$31,648	\$1,582							
Page	60	1	1.67%	\$750	\$38							
Williams	56	1	1.79%	\$0	\$0							

Table 4-38: Estimated Population Exposed to High and Medium Wildfire Hazard											
Community	Total Population	Population Exposed	Percent of Population Exposed	Total Population Over 65	Population Over 65 Exposed	Percent of Population Over 65 Exposed					
HIGH											
County-Wide Totals	139,881	33,175	23.72%	8,906	2,174	24.41%					

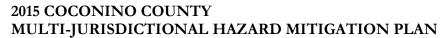
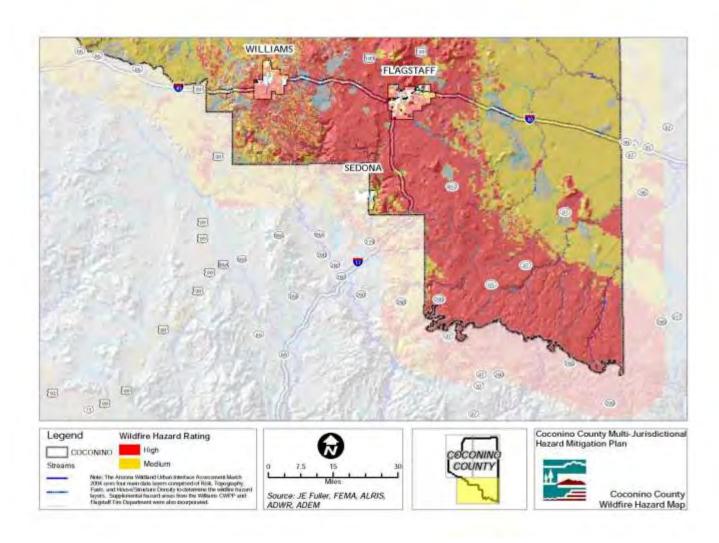




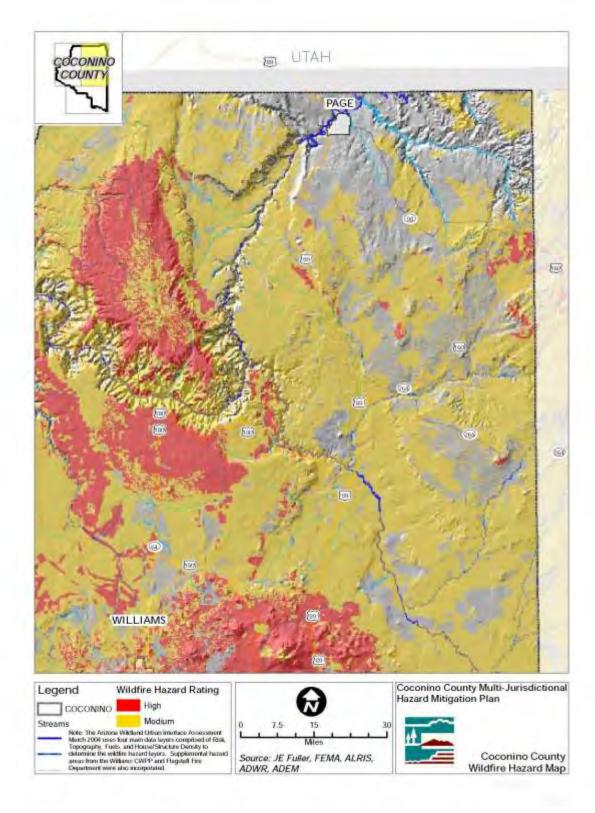
Table 4-38: Estimated Population Exposed to High and Medium Wildfire Hazard											
Community	Total Population	Population Exposed	Percent of Population Exposed	Total Population Over 65	Population Over 65 Exposed	Percent of Population Over 65 Exposed					
Unincorporated Coconino Co	65,478	17,907	27.35%	3,347	1,072	32.03%					
Flagstaff	7,283	0	0.00%	393	0	0.00%					
Page	30,941	14,242	46.03%	1,994	988	49.57%					
Williams	3,326	317	9.54%	356	37	10.40%					
	<u>'</u>	MEI	DIUM	<u>'</u>	'	<u> </u>					
County-Wide Totals	139,881	27,429	19.61%	8,906	2,075	23.29%					
Unincorporated Coconino County	65,478	4,981	7.61%	3,347	256	7.64%					
Flagstaff	7,283	0	0.00%	393	0	0.00%					
Page	30,941	6,593	21.31%	1,994	524	26.30%					
Williams	3,326	57	1.73%	356	7	1.94%					





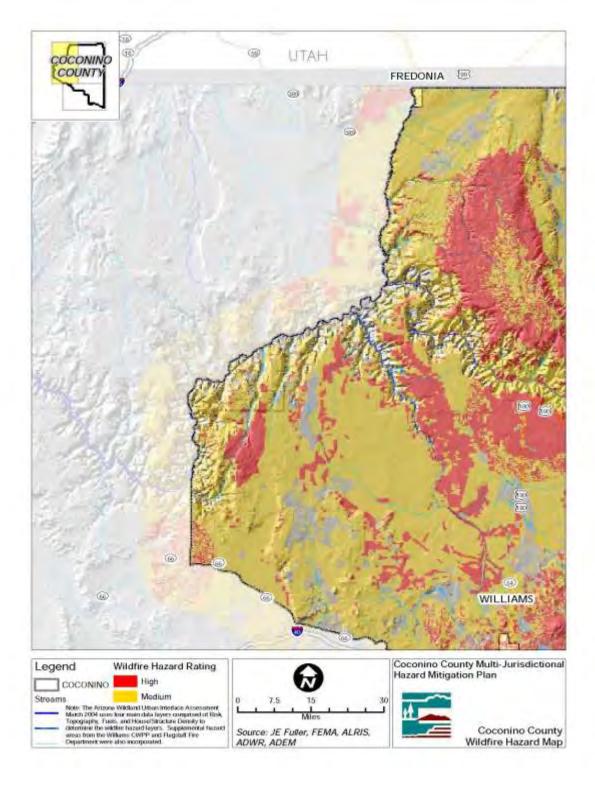
Map 4-16: Wildfire Hazard 1





Map 4-17: Wildfire Hazard 2





Map 4-18: Wildfire Hazard 3





25.01%

13.92%

Table 4-39: Coconino Co I	Estimated Building	Exposure to	Wildfire
---------------------------	---------------------------	--------------------	----------

	Residential		Comi	mercial	Industrial		Summary		
Coconino Co HAZUS	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)
County-Wide Totals	50,471	\$8,932,983	2384	\$2,500,987	611	\$389,374	\$11,823,344		
High Hazard Exposure	15,103	\$2,953,453	550	\$469,979	179	\$97,382	\$3,520,815	20%	\$704,163
Medium Hazard Exposure	11,797	\$1,629,907	350	\$363,721	87	\$54,184	\$2,047,812	5%	\$102,391
Coconino Co HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact			

18.79%

14.54%

29.24%

14.17%

Table 4-40: Flagstaff Estimated Building Exposure to
--

33.06%

18.25%

23.09%

14.67%

29.92%

23.37%

High Hazard Exposure

Medium Hazard Exposure

Table 4 40. Flagstaff Estimated Bullating Exposure to Wilding									
	Residential Commercial			Inc	dustrial	Summary			
Flagstaff (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)
Community-Wide Totals	16,521	\$3,918,391	1,320	\$1,485,011	322	\$232,205	\$5,635,607		
High Hazard Exposure	5,142	\$1,258,234	232	\$205,454	69	\$29,348	\$1,493,036	20%	\$298,607
Medium Hazard Exposure	1,358	\$325,203	82	\$83,779	22	\$13,277	\$422,259	5%	\$21,113
Flagstaff (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact			
High Hazard Exposure	31.12%	32.11%	17.56%	13.84%	21.44%	12.64%			



 Medium Hazard Exposure
 8.22%
 8.30%
 6.18%
 5.64%
 6.91%
 5.72%

Table 4-41: Page Estimated Building Exposure to Wildfire											
	Res	sidential	Commercial			lustrial	Summary				
Page (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)		
Community-Wide Totals	2,568	\$383,986	80	\$65,815	13	\$3,671	\$453,473				
High Hazard Exposure	0	\$0	0	\$0	0	\$0	\$0	20%	\$0		
Medium Hazard Exposure	0	\$0	0	\$0	0	\$0	\$0	5%	\$0		
Page (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact					
High Hazard Exposure	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%					
Medium Hazard Exposure	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%					

Table 4-42: Williams Estimated Building Exposure to Wildfire												
	Residential Commercial Industrial		Commercial			lustrial	Summary					
Williams (Coconino Co) HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)			
Community-Wide Totals	1,469	\$200,380	113	\$69,440	13	\$4,985	\$274,805					
High Hazard Exposure	145	\$26,436	13	\$7,312	1	\$82	\$33,830	20%	\$6,766			
Medium Hazard Exposure	26	\$8,258	5	\$3,362	0	\$16	\$11,637	5%	\$582			



Williams (Coconino Co) HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact
High Hazard Exposure	9.87%	13.19%	11.18%	10.53%	6.15%	1.64%
Medium Hazard Exposure	1.80%	4.12%	4.46%	4.84%	1.16%	0.32%

Table 4-43: Unincorporated Coconino Co Estimated Building Exposure to Wildfire									
	Resi	dential	Commercial		Ind	ustrial	Summary		
Uninc Coconino Co HAZUS Summary	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Building Count	Potential Economic Impact (x\$1000)	Total of All Economic Impact (x\$1000)	Loss-to- Exposure Ratio	Total Estimated Loss (x\$1000)
Community-Wide Totals	18,435	\$2,935,368	583	\$445,427	205	\$107,147	\$3,487,942		
High Hazard Exposure	9,513	\$1,605,893	290	\$230,210	103	\$61,692	\$1,897,795	20%	\$379,559
Medium Hazard Exposure	4,848	\$686,407	140	\$117,218	40	\$18,824	\$822,449	5%	\$41,122
Uninc Coconino Co HAZUS Summary	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact	% Building Count	% Potential Economic Impact			
High Hazard Exposure	51.60%	54.71%	49.70%	51.68%	50.15%	57.58%			
Medium Hazard Exposure	26.30%	23.38%	23.96%	26.32%	19.69%	17.57%			



Regarding human vulnerability, a total population of 33,175 and 27,429 people, or 23.72% and 19.61% of the total 2009 Coconino County projected population, is potentially exposed to a high and medium hazard wildfire event, respectively. Typically, deaths and injuries not related to firefighting activities are rare. However, it is feasible to assume that at least one death and/or injury may be plausible. There is also a high probability of population displacement during a wildfire event, and especially in the urban wild land interface areas.

It is duly noted that the loss and exposure numbers presented above represent a comprehensive evaluation of the County as a whole. It is unlikely that a wildfire would occur that would impact all of the high and medium wildfire hazard areas at the same time. Accordingly, actual event based losses and exposure are likely to be only a fraction of those summarized above.

Vulnerability – Development Trend Analysis

By its very definition, the WUI represents the fringe of urban development as it intersects with the natural environment. As previously discussed, wildfire risks are very significant for a sizeable portion of the county. Any future development will only increase the UWI areas and expand the potential exposure of structures to wildfire hazards. The various CWPPs address mitigation opportunities for expanding UWI areas and provide recommended guidelines for safe building and land-use practices in wildfire hazard areas.

Sources

ADEM, 2009, State of AZ Multi-Hazard Mitigation Plan, 2010.

Fisher, M., 2004, AZ Wild land Urban Interface Assessment, 2003, prepared for the AZ Interagency Coordination Group.

http://www.azsf.az.gov/UserFiles/PDF/Arizona%20Wildland%20Urban%20Interface%20Assessment%2005MAR04.pdf

Flagstaff Fire Dept. & Coconino Co, 2009, Historic data provided by the Flagstaff Fire Dept. (Local Planning Team) and Coconino Co in 2009.

National Park Service, 2008 web link found at: http://www.nps.gov/grca/fire/report/index.htm



4.5.8 Winter Storm

Description

Severe snow storms affect many aspects of life in the County, including transportation, emergency services, utilities, agriculture and the supply of basic subsistence to isolated communities. Interstates 40 and 17 have produced numerous fatal multi-car accidents due to heavy winter snowfall and icy road conditions. Heavy snowfalls can also leave motorists stranded in their vehicles with potentially disastrous results like hypothermia and carbon-monoxide poisoning. Significant snow storms can also hinder both ground and air emergency services vehicles from responding to accidents or other emergencies. Remote areas and communities can be easily cut-off from basic resources such as food, water, electricity, and fuel for extended periods during a heavy storm. Extremely heavy snow storms can produce excessive snow loads that can cause structural damage to under-designed buildings. Agricultural livestock can also be vulnerable to exposure and starvation during heavy snow storms.

Freezing rain is formed as snow falls through a warm zone in the atmosphere completely melting the snow. The melted snow then passes through another zone of cool air "super cooling" the rain below freezing temperature while still in a liquid state. The rain then instantly freezes when it comes in contact with the ground or other solid object. Because freezing rain hits the ground as a rain droplet, it conforms to the shape of the ground, making one thick layer of ice. Sleet is similar to hail in appearance but is formed through atmospheric conditions more like freezing rain. The difference is the snowflakes don't completely thaw through the warm zone and then freeze through the cool air zone closer to the ground. Sleet typically bounces as it hits a surface similar to hail. Sleet is also informally used to describe a mixture of rain and snow and is sometimes used to describe the icy coating on trees and power lines.

Sleet and freezing rain can cause slippery roadway surfaces and poor visibility leading to traffic accidents, and can leave motorists stranded in their vehicles with potentially disastrous results like hypothermia and carbon monoxide poisoning. Heavy sleet or freezing rain can produce excessive ice-loads on power lines, telecommunication lines and other communication towers, tree limbs, and buildings causing power outages, communication disruptions, and other structural damage to under-designed facilities.

The warmer oceans and atmosphere observed in the recent past lead to increased evaporation and increased water vapor in the atmosphere. The higher water vapor values translate directly into greater perceptible water – the amount of liquid water found in a column of air, if all the water were squeezed out of the column of air. Increased atmospheric moisture can result in more extreme precipitation events, both rain and snow events. For Coconino County, there is a possibility of higher intensity winter storms, though there is no clear trend, but rather an increase in variability of winter storms, including both higher snowfall events and months with no winter storms at all.

History

Winter snows are the lifeblood of water supplies for most of Coconino County. However, winter storms are also the most deadly natural hazard to impact Coconino County. Coconino County has endured at least 20 fatalities and 79 injuries as a result of snow storms in the last 50 years. The following are highlights of the more prominent snow storm events impacting Coconino County:

- January 18-23, 2010, during the six day period from January 18th through 23rd, areas of Flagstaff received between 45 and 54 inches of snow. The event resulted in several roof collapses, water damage and ice damage.
- March 2008, an intense winter snow shower reduced visibility to zero on Interstate 40 near Flagstaff, leading to a 139 vehicle pile-up covering 4 miles on both sides of the highway. Eastbound lanes were closed for 14 hours, westbound for 16 hours. Three deaths were reported.



along with 10 people hospitalized with serious injuries and another 35 people treated and released. The damage estimate for this multi-vehicle accident is \$600,000 (NCDC, 2008).

- December 2007, seventeen inches of snow fell at the Flagstaff Airport. Twenty-six inches of snow fell near Blue Ridge. Over 200 traffic accidents and slide offs were reported by law enforcement departments. Nine of those involved minor injuries and there was one fatality. A strong area of low pressure from the Pacific Northwest brought heavy rain, very windy conditions, and high elevation snow on Friday December 7th through Saturday December 8th. The next portion of the storm system began to move across the state on late Sunday December 9th and lasted through Tuesday December 11th. This brought heavy snow to many areas along and north of the Mogollon Rim and the White Mountains (NCDC, 2008).
- January 2006, a low pressure center moving into Arizona and a cold easterly flow into the into the
 Little Colorado River Valley, White Mountains, and Eastern Mogollon Rim caused widespread
 freezing drizzle and freezing rain. Law enforcement officers and the general public reported 47
 wrecks and roll-overs between Winslow and the New Mexico State Line and south to Show Low.
 Five people died and many others were injured (NCDC, 2008).
- February 1995, two people died in a vehicle accident when their vehicle lost control on the icy road and struck a parked tractor-semitrailer in Flagstaff (NCDC, 2008). In January of 1997, a heavy winter storm moved through the northern part of the state dropping 34 inches of snow on the Flagstaff are and forcing the closure of Interstates 17 and 40. The total disaster cost to the State of Arizona was \$1.6 million in 1997 dollar (ADEM, 2009).
- January 1995, heavy snows and wind downed power lines and caused a 60 foot tree to fall on a
 mobile home in the Flagstaff area. Storm related damages were estimated at over \$50,000.
 (NCDC, 2008).
- December 1967 to January 1968, the worst winter storm to impact Coconino County occurred, paralyzing most of northern Arizona and bringing snow to much of the state. The storm was actually two storms, with the second following closely on the heels of the first. During the nine day period, 86.0 inches of snow fell at Flagstaff. On December 14, a one-day state record of 32.5 inches at Sedona and 31.0 inches at the South Rim of the Grand Canyon. Heavy snows isolated Page and other Northern Arizona communities for approximately two weeks. People on the Navajo reservation were instructed to use ashes from their stoves to write distress signals in the snow that could be spotted from the air. Most roads were closed and emergency food had to be airlifted into the communities. The total disaster cost to the State of Arizona was \$2.2 million in 1997 dollars. A total of eight people died of exposure (ADEM, 2009).



2010 Winter Storm event



Strip mall on South Milton, Flagstaff





Amtrak Station, downtown Flagstaff

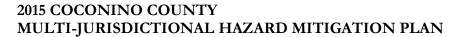


Looking south on Beaver Street

Probability and Magnitude

Snow level measurements are recorded daily across the United States and can be used to estimate the probability and frequency of severe winter storms. In Arizona, there is a 5% annual chance that snow depths between zero and 25 centimeters will be exceeded, a snowfall probability that is among the lowest in the nation (ADEM, 2009). However, snowfall extremes can occur in Arizona with a much higher chance in Coconino County and can have serious effects.

The NCDC compiled snow climatology statistics using historic record data from statewide NWS cooperative observer sites for 1948 to 1996. Each station in Arizona and the nearest stations in California, Nevada, Utah, Colorado, and New Mexico were queried from this data set to establish maps showing





statistical projections of the snow depths for various recurrence intervals. The resultant map can then be used to conceptually estimate potential snow depths for each of the recurrence intervals at locations within the state. Maps 3 through 6 depict the geographically varying levels of exposure to snow depths. Map 4-21 presents the results for the 3-day, 100-year events which could be reasonably considered the worst case scenario. According to the following maps, most of the County could experience a 100-year, 3-day snow depth of over 14 inches with some communities receive well over 2 or 3 feet of snow.

Vulnerability – CPRI Results

Table 4-44: CPR	Table 4-44: CPRI Rating for Snow Storms				
Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Coconino Co.	Highly Likely	Critical	12-24 hours	<1 week	3.30
Flagstaff	Highly Likely	Critical	12-24 hours	<1 week	3.30
Fredonia	Likely	Negligible	12-24 hours	<24 hours	2.15
Page	Likely	Limited	6-12 hours	<1 week	2.70
Tusayan	Highly Likely	Critical	12-24 hours	>1 week	3.40
Williams	Likely	Limited	6-12 hours	<24 hours	2.60
County-wide average CPRI = 2.91					
Note: Maximum CPR	Note: Maximum CPRI score is 4.00.				

Vulnerability – Loss Estimations

The National Weather Service in Flagstaff²¹, uses the following criteria for issuing warnings about winter storm weather:

- 1. **Blizzard Warning:** Sustained winds or frequent gusts of 35 mph or more, and visibility frequently below 1/4 mile in considerable snow and/or blowing snow, and above conditions are expected to prevail for 3 hours or longer.
- 2. Winter Storm Warning: Issued when more than one winter hazard is involved producing life threatening conditions, such as a combination of heavy snow, strong winds producing widespread blowing and drifting snow, freezing rain, or wind chill.
- 3. Heavy Snow Warning Criteria:

Above 8500 ft	12 inches/12 hrs	18 inches/24 hrs
7000 to 8500 ft	8 inches/12 hrs*	12 inches/24 hrs*
5000 to 7000 ft	6 inches/12 hrs	10 inches/24 hrs
Below 5000 ft	2 inches/12 hrs	4 inches/24 hrs

^{*(}Flagstaff is in this range)

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²¹ Based on information posted at the following NWS URL: http://www.wrh.noaa.gov/fgz/safety/criteria.php?wfo=fgz



4. Snow Advisory Criteria:

Above 8500 ft	6 to 12 inches/12hrs	12 to 18 inches/24 hrs
7,000-8,500 ft	4 to 8 inches/12 hrs*	8 to 12 inches/24 hrs*
5,000-7,000 ft	3 to 6 inches/12 hrs	6 to 10 inches/24 hrs
Below 5,000 ft	1 to 2 inches/12 hrs	2 inches/24 hrs**

^{*(}Flagstaff's elevation)

- **5. Blowing Snow Advisory Criteria:** Visibility frequently at or below 1/4 mile.
- **6. High Wind Warning Criteria:** Issued for strong winds not associated with severe local storms. These include: gradient, mesoscale, and channeled winds; Foehn/Chinook/downslope winds; and winds associated with tropical cyclones. The criteria:

Sustained winds	40 mph or greater	last 1 hr or longer
Wind gusts	58 mph or greater	for any duration

7. Wind Advisory: Issued for the same types of wind events as a High Wind Warning, but at lower speed thresholds. The criteria:

Sustained winds	30-39 mph	last 1 hr or longer
Wind gusts	40-57 mph	for any duration

- **8. Visibility Hazards:** Visibility reduced to 1/4 mile or less by fog, blowing dust/sand, and smoke.
- **9.** Wind Chill: Issued for a wind chill factor of minus 20 °F or colder.
- **10. Freezing Rain/Drizzle, or Sleet:** widespread, dangerous, and damaging accumulations of ice or sleet.
- 11. Frost or Freeze Warning: Issued when temperatures are critical for crops and sensitive plants. Criteria is season dependent, but usually a freeze warning is appropriate when temperatures are expected to fall below freezing for at least 2 hours.

Inspection of map 4-21 would indicate that for much of Coconino County, there is a 10% probability that a heavy snow warning could be issued in any given year. All of the county population and assets are exposed to winter storm. Given the historic record, it is estimated that an annual loss of \$500,000 could be expected. It is also anticipated that at least one fatality and multiple injuries will result.

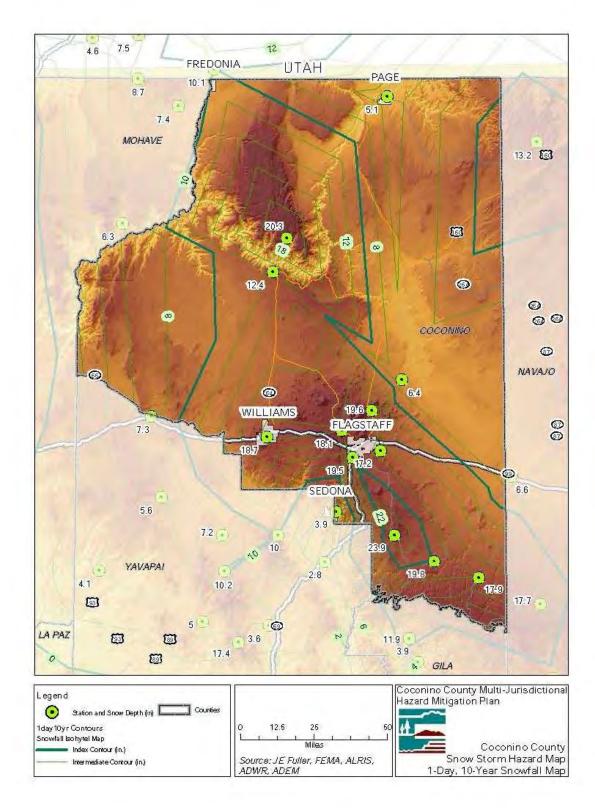
Sources

AZ Division of Emergency Management, 2009, AZ Hazard Mitigation Plan, 2010.

U.S. Dept of Commerce, National Climatic Data Center, 2008, Storm Events Database, accessed via the following URL: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

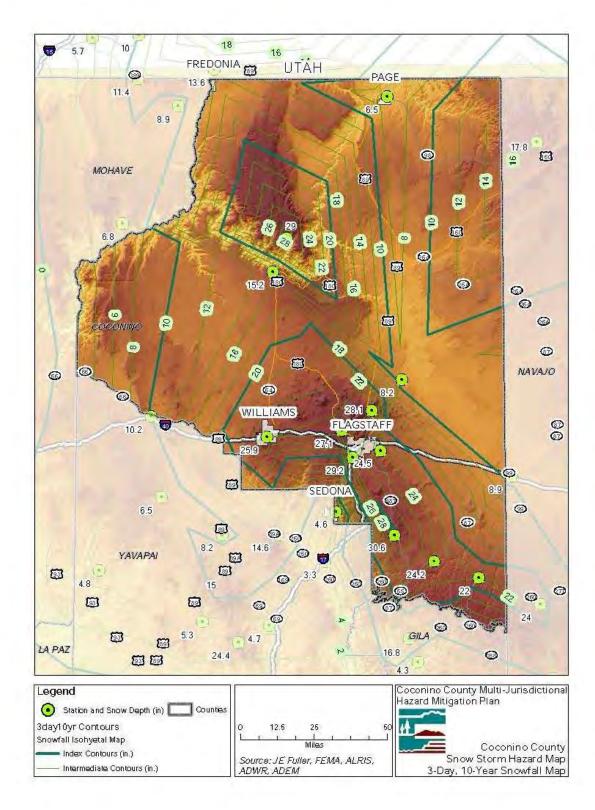
^{**}or snow accumulation in any location where it is a rare event.





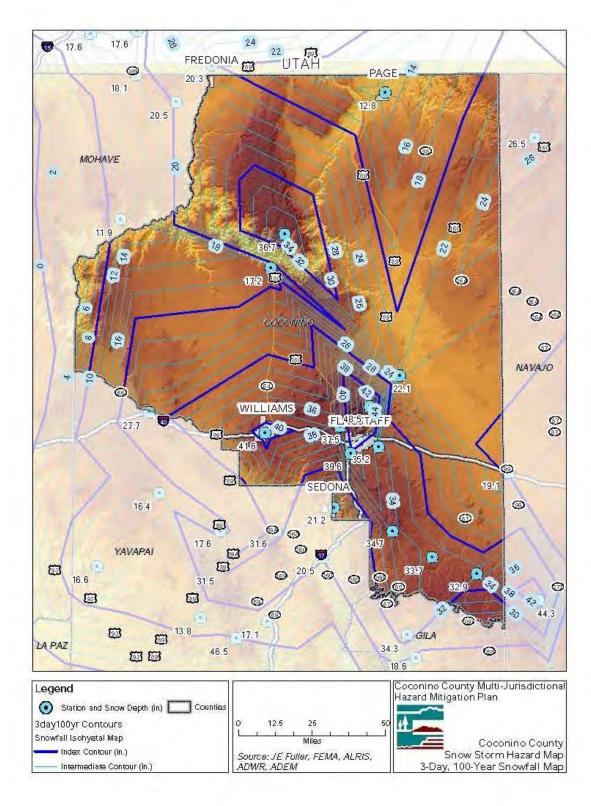
Map 4-19: Snow Storm Hazard 1





Map 4-20: Snow Storm Hazard 2





Map 4-21: Snow Storm Hazard 3



SECTION 5: MITIGATION STRATEGY

5.1 Section Changes

• The Capability Assessment now analyzes the 'Planning and Regulatory Capabilities', 'Administrative and Technical Capabilities' and 'Financial Capabilities' and the newly added 'Education and Outreach Capabilities of each jurisdiction.

The mitigation strategy provides the "what, when, and how" of actions that will reduce or possibly remove the community's exposure to hazard risks. The primary components of the mitigation strategy are generally categorized into the following:

Goals and Objectives

Capability Assessment

Mitigation Actions/Projects

The 2010 Plan mitigation strategy was reviewed and updated by the Planning Team. Specifics of the changes and updates are discussed in the subsections below.

5.2 Goals and Objectives

The goal and objectives of this Plan were carefully reviewed and analyzed by the Planning Team. The objectives in the previous Plan were believed to be overly detailed and redundant as they described the planning area. Although the goal and objectives have changed, the basic concepts remain the same: protect life and property, educate and mitigate.

Goal

Reduce or eliminate the impact from hazards identified in this Plan.

Objectives

- Reduce or eliminate hazard-related loss of life and injuries.
- Reduce or eliminate hazard related damage to infrastructure and property.
- Promote public awareness of hazards and encourage individual responsibility and preparedness for hazard related events.
- Encourage the development and implementation of long-term, cost effective and environmentally sound mitigation projects.

5.3 Capability Assessment

An important component of the Mitigation Strategy is a review of each participating jurisdiction's resources in order to identify, evaluate, and enhance the capacity of local resources to mitigate the effects of hazards by implementing this Plan. The capability assessment is comprised of several components:

- Planning and Regulatory The implementation of ordinances, policies, local laws and state statutes, and plans and programs that relate to guiding and managing growth and development.
- Administrative and Technical Refers to the community's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively.





- Financial The resources that a jurisdiction has access to or is eligible to use to fund mitigation measures.
- Education and Outreach Refers to education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information.





Table 5-1: Capability Assessment for Coconino County

Table 5-1: Capability Assessment for	Coconino Co	•	
PLANS	Yes/No Year	Does the plan address hazards? Does the plan ID projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?	
Capital Improvements Plan	Yes	2015. Yes, it addresses all hazards, Identifies projects and includes mitigation strategies, and can be used to implement mitigation actions.	
Community Wildfire Protection Plan	Yes	Yes, these plans address hazards, and provide for: identification of values, risks and threats, identify projects to include in the mitigation strategy, community preparedness and protection capability, and implementation and monitoring actions. CWPP's currently exist for Tusayan (2013), Blue Ridge area and Mogollon Rim, Greater Flagstaff Area. This plan also covers communities in the Coconino and Kaibab National Forests of Coconino County.	
Comprehensive/Master Plan	Yes	Yes, it addresses all hazards, Identifies projects and includes mitigation strategies, and can be used to implement mitigation actions. It is currently being updated.	
Continuity of Operations Plan	Yes	Yes, it addresses all hazards and is always in a state of being updated.	
Economic Development Plan	No		
Emergency Operations Plan	Yes	Yes, it addresses all hazards. Yes, it can be used to implement mitigation actions via application of applicable ESF Annexes.	
Stormwater Management Plan	Yes	Yes, it addresses all hazards, identifies projects in the mitigation strategy, and can be used to implement mitigation actions. This is included in county ordinances.	
Transportation Plan	Yes	Yes, it addresses all hazards, identifies projects and includes mitigation strategies, and can be used to implement mitigation actions.	
BUILDING CODES, PERMITTING,	Yes/No	What type of codes?	
INSPECTIONS	1 es/No	Are codes adequately enforced?	
Building Codes	Yes	The 2012 IBC Code Suite. Yes, codes are adequately enforced.	
Site plan review requirements	Yes	Yes, codes are adequately enforced	
LAND USE PLANNING &		Is the ordinance effective for reducing hazard impacts?	
ORDINANCES		Is the ordinance adequately administered and enforced?	
Floodplain ordinance	Yes	Yes, 2013 updated	
Subdivision ordinance	Yes	Yes, 2013 updated	
Zoning ordinance	Yes	Yes, 2015	





How can capabilities be expanded and improved to reduce risk? By incorporating into the plans the ability to further implement and follow through with greater levels of enforcement of each ordinance.

ADMINISTRATIVE and TECHNICAL				
ADMINISTRATION	Yes/No	Describe capability.		
ADMINISTRATION	1 68/110	Is coordination effective?		
Mutual aid agreements	Yes	Yes, Coconino Co participates in the AZMAC (Arizona Mutual Aid Compact)		
Planning Commission	Yes	They are effective in communication with the Board of Supervisors.		
	Yes/No	Is staff trained on hazards and mitigation?		
TECHNICAL STAFF	FT/PT	Is coordination between agencies and staff effective?		
		Have skills/expertise been used to assess/mitigate risk in the past?		
Building Official	Yes	Yes to all		
Community Planner	Yes	Yes to all		
Emergency Manager	Yes	Yes to all		
Engineer	Yes	Yes to all		
Floodplain Manager/Administrator	Yes	Yes to all		
GIS/HAZUS Coordinator	Yes	Yes to all		
Grant writer	Yes	This position does not currently provide grants service on mitigation projects.		

How can capabilities be expanded and improved to reduce risk? By continuing to utilize and seek improved methods for including the necessary technical and planning staff in the development and updates of emergency operations plans, financial planning and mitigation planning efforts. An important component is the use of trained grant writers with the knowledge and skill sets to research and apply for federal funding opportunities.

FINANCIAL				
FINANCIAL	Yes/No	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?		
Capital improvements project funding	Yes	Funding source has been used in past for roads and flood control and could be used for future mitigation actions.		
Community Development Block Grant	Yes	This source has been used for low income housing rehabilitation and could be used for future mitigation actions.		
Authority to levy taxes for specific purposes	Yes	Yes, examples include the recently passed Proposition 403 (road maintenance sales tax), Flood Control Tax was upgraded in 2011, and the 2012 Public Health District tax. These sources of revenue could be used for future mitigation actions.		





Impact fees for new development	No	
Incur debt through special tax bond	Yes	Yes, an example is the use by Facilities for courthouse remodel. This source could be used for future Mitigation actions.
Incur debt through general obligation bonds	Yes	This has not been used in the past but that is a possibility for future needs.

How can capabilities be expanded and improved to reduce risk? Develop new and creative ways to acquire funding such as new legislation proposals to open the doors for improved funding opportunities.

EDUCATION and OUTREACH	Access /	
PROGRAM / ORGANIZATION	Eligibility (Yes/No)	Describe program/organization and how it relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Firewise Communities certification	Yes	The Flagstaff Fire Dept and the individual Fire Depts/Districts within Coconino Co work in their respective communities to establish disaster resilience. The Community Wildfire Protection Plans also serve to establish future mitigation projects and actions to support disaster resilience.
Storm Ready certification	Yes	This certification was obtained through the National Weather Service and is due for recertification in late 2015
Citizen groups focused on emergency preparedness, environmental protection, etc.	Yes	CERT (Community Emergency Response Team), MRC (Medical Reserve Corps), ARES (Amateur Radio Emergency Services), Faith Based organizations such as the First Baptist support group, Salvation Army, and UWNA (United Way of No AZ). These organizations provide First Responder Support and Emergency Management and EOC support to local communities and local government during times of disaster and preparedness training for local needs.
Public education/information programs (fire safety, household preparedness, responsible water use, etc)	Yes No (for water use)	Coconino Co frequently addresses public information needs through a variety of mechanisms. The local government organizations utilize a well –developed and coordinated PIO group with partners from all levels of government including city, county departments and federal and state offices. This is especially effective during times of disaster. Coconino Co Emergency Management utilizes public presentations and media outlets (radio, print) to provide public outreach on emergency preparedness. The Coconino Co Website is a primary tool for dissemination of public information.
Public-private partnership initiatives addressing disaster-related issues	Yes	Examples of organizations for this effort include VOAD (Volunteer Organizations Active in Disaster), LEPC (Local Emergency Planning Committee) for addressing hazardous materials issues, and PFAC (Ponderosa Fire Advisory Council) and WFAC (Wildland Fire Advisory Council) which brings together local, state, and federal fire resources to enhance efforts in pursuit of a Common Operating Picture for community fire protection.

How can capabilities be expanded and improved to reduce risk? This can be accomplished by including the organizations in our public outreach, planning, training and overall preparedness efforts and real time events.



Table 5-2: Capability Assessment for Flagstaff			
Table 5 2. Capability Assessment for	i iagstaii	PLANNING and REGULATORY	
PLANS	Yes/No Year	Does the plan address hazards? Does the plan ID projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?	
Capital Improvements Plan	Yes/5-yr plan updated annually	Yes, Yes, Yes	
(Greater Flagstaff Area) Community Wildfire Protection Plan	Yes/Updat ed in 2012	Yes, Yes, Yes	
Comprehensive/Master Plan (Flagstaff Regional Plan)	Yes/2014	Yes, No, No	
Continuity of Operations Plan	No	The plan is in process and anticipated completion is in 2015	
Economic Development Plan	Yes/2014	Yes, No, No	
Emergency Operations Plan	Yes/2013	Yes, No, Yes	
Stormwater Management Plan	Yes/Annu ally	Yes, Yes, Yes	
Transportation Plan	Yes/2014	Yes, Yes, Yes	
BUILDING CODES, PERMITTING, INSPECTIONS	Yes/No	What type of codes? Are codes adequately enforced?	
Building Codes	Yes	2012 Int'l Building Code, 2012 Int'l Plumbing Code, 2012 Int'l Fuel Gas Code, 2012 Int'l Residential Code, 2012 Int'l Mechanical Code, 2011 National Electric Code, 2009 ICC A117.1 Accessible and Usable Building Code, 1997 Uniform Code for the Abatement of Dangerous Buildings, 1997 Uniform Administrative Code, 1997 Uniform House Code. Codes are adequately and appropriately enforced though the Code Enforcement Section.	
Site plan review requirements	Yes		
COF Wildland Urban Interface Code	Yes	Yes, codes adopted by City Council in 2008	
LAND USE PLANNING & ORDINANCES	Yes/No	Is the ordinance effective for reducing hazard impacts? Is the ordinance adequately administered and enforced?	
Floodplain ordinance	Yes	Yes. Yes	
Subdivision ordinance	Yes	Yes. Yes	
Zoning ordinance	Yes	Yes. Yes	
How can capabilities be expanded and improved to reduce risk? The more financial resources available to the City drive the number of hazard mitigation			





projects explored.				
	ADMINISTRATIVE and TECHNICAL			
ADMINISTRATION	Yes/No	Describe capability. Is coordination effective?		
Mutual aid agreements	Yes	Agreements are in place with multiple Jurisdictions; The COF joined AZMAC and revised the Greater Flagstaff Fire Service Mutual Aid IGA. Agreements are effective in assisting with mitigation.		
Planning (and Zoning) Commission	Yes	Advisory board to the Council on matters related to growth and physical development of the City; conducts public hearings on amendments to the Zoning Map, and public meetings on preliminary subdivision plats.		
Board of Adjustment	Yes	Hears and decides appeals of staff determinations of the Zoning Code.		
TECHNICAL STAFF	Yes/No FT/PT	Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective? Have skills/expertise been used to assess/mitigate risk in the past?		
Building Official	Yes/FT	Yes, Yes, Yes		
Planning Director (and Staff)	Yes/FT	Yes, Yes, Yes		
Emergency Manager	Yes/PT	Yes, Yes, Yes		
City Engineer (and Staff)	Yes/FT	Yes, Yes, Yes		
Floodplain Manager/Administrator	Yes/FT	Yes, Yes, Yes		
GIS/HAZUS Coordinator	Yes/FT	No, Yes, Yes		
Grant writer	Yes/FT	Yes, Yes, Yes (Disaster Recovery Management also)		
Firewise Specialist	Yes/FT	Yes, Yes, Yes,		
How can canabilities be avanded and improved to reduce risk? Additional training of staff in bazard mitigation and financial recourses to nursue				

How can capabilities be expanded and improved to reduce risk? Additional training of staff in hazard mitigation and financial resources to pursue mitigation projects.

FINANCIAL			
FINANCIAL	Yes/No	Has the funding resource been used in past and for what type of activities?	
FINANCIAL		Could the resource be used to fund future mitigation actions?	
Capital improvements project funding	Yes	Yes, Transportation improvement projects, Stormwater/ winter storm drainage projects, water	
Capital improvements project funding	res	supply and storage protection, fire prevention/Protection. Yes	
Community Development Block Grant	Yes	No, Possibly	
Authority to levy taxes for specific purposes	Yes	Yes, Yes	
Impact fees for new development	Yes	Yes, Limited to public safety Equipment and facilities, No	
Incur debt through special tax bond	Yes	Yes, Public Safety Radio System Bond, Flagstaff Watershed Protection Program (FWPP) bond,	
	1 68	Road Repair and Street Safety tax, Yes	
In some dight through comment abligation bonds	Yes	Yes, Forest Fuels Treatments, \$16.5M in street/utility improvements, \$42M for Municipal	
Incur debt through general obligation bonds		Services Maintenance Facility, Yes	
TT			

How can capabilities be expanded and improved to reduce risk? Public education and awareness of potential hazards could drive additional funding for mitigation related projects.





EDUCATION and OUTREACH			
PROGRAM / ORGANIZATION	Access / Eligibility (Yes/No)	Describe program/organization and how it relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?	
Firewise (Fire-Adapted) Communities certification	Yes	Develops fire adapted communities, yes	
StormReady certification	No	Coconino County as a whole is certified	
Citizen groups focused on emergency preparedness, environmental protection, etc.	Yes	Red Cross, Woods Watch, Emergency Operations Center Volunteers, Yes	
Public education/information programs (fire safety, household preparedness, responsible water use, etc)	Yes	Reverse 911, Code Red emergency notification system, Stormwater public outreach, Water Conservation Program, Firewise, The City has a Budget Performance Measurement the priority of, "Resiliency and preparedness efforts", Yes	
Public-private partnership initiatives addressing disaster-related issues	Yes	Red Cross, Pipeline Companies, FWPP, BNSF Railroad, Northern Arizona University, Purina companies, United Way of Northern Arizona, and various other non-profit agencies, Flagstaff Unified School District, Flagstaff Fire Occupancy inspection Program.	
How can capabilities be expanded and improved to reduce risk? Increase funding to support mitigation services.			

Table 5-3: Capability Assessment for Fredonia				
	PLA	NNING and REGULATORY		
PLANS	Yes/No Year	Does the plan address hazards? Does the plan ID projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?		
Capital Improvements Plan	No			
Community Wildfire Protection Plan	No			
Comprehensive/Master Plan	Yes, 1994			
Continuity of Operations Plan	No			
Economic Development Plan	No			
Emergency Operations Plan	Yes, 1986	Yes, yes		
Stormwater Management Plan	No			
Transportation Plan	No			
BUILDING CODES, PERMITTING,	Yes/No	What type of codes?		



INSPECTIONS		Are codes adequately enforced?
Building Codes	Yes	Town Code Chapter 5 & 14
Site plan review requirements	Yes	Chapter 14
LAND USE PLANNING & ORDINANCES		Is the ordinance effective for reducing hazard impacts?
LAND USE FLANNING & ORDINANCES		Is the ordinance adequately administered and enforced?
Floodplain ordinance	Yes	Yes, yes
Subdivision ordinance	Yes	Yes, not in the past
Zoning ordinance	Yes	Yes, yes
	ADMIN	NISTRATIVE and TECHNICAL
ADMINISTRATION	Yes/No	Describe capability.
ADMINISTRATION	1 es/No	Is coordination effective?
Mutual aid agreements	Yes	With Kane county, help when needed
Planning Commission	Yes	Our zoning and planning, help make sure code is followed
	Yes/No FT/PT	Is staff trained on hazards and mitigation?
TECHNICAL STAFF		Is coordination between agencies and staff effective?
	1 1/1 1	Have skills/expertise been used to assess/mitigate risk in the past?
Building Official	Yes/ PT	
Community Planner	No	Town manager, some training, good coordination, no skills
Emergency Manager	Yes/ft	Town Marshall, trained, coordination effective, has skills
Engineer	No	Public Works Director, coordination is effective, has training, has skills
Floodplain Manager/Administrator	Yes/ FT	Public Works Director, coordination is effective, has training, has skills
GIS/HAZUS Coordinator	No	
Grant writer	Yes	Some training, coordination is effective, no
		FINANCIAL
FINANCIAL	Yes/No	Has the funding resource been used in past and for what type of activities?
FINANCIAL	1 65/140	Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Yes	Infrastructure, possibly
Community Development Block Grant	Yes	Infrastructure, possibly





Authority to levy taxes for specific purposes	No	
Impact fees for new development	Yes	On hold at the moment,
Incur debt through special tax bond	no	
Incur debt through general obligation bonds	Yes	Cannot afford to pay back loan
	EDU	CATION and OUTREACH
PROGRAM / ORGANIZATION	Access / Eligibility (Yes/No)	Describe program/organization and how it relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Firewise Communities certification	No	
StormReady certification	No	
Citizen groups focused on emergency preparedness, environmental protection, etc.	Yes	
Public education/information programs (fire safety, household preparedness, responsible water use, etc)	Yes	
Public-private partnership initiatives addressing disaster-related issues	No	

Table 5-4: Capability Assessment for Page				
PLANNING and REGULATORY				
	Yes/No	Does the plan address hazards?		
PLANS		Does the plan ID projects to include in the mitigation strategy?		
	Year	Can the plan be used to implement mitigation actions?		
Capital Improvements Plan	Yes	No, No, No		
Community Wildfire Protection Plan	No			
Comprehensive/Master Plan	No			
Continuity of Operations Plan	Yes	Yes, No, Yes		
Economic Development Plan	Yes	No, No, No		



Emergency Operations Plan	Yes	Yes, No, Yes
Stormwater Management Plan	Yes	No, No, No
Transportation Plan	Yes	No, No, No
BUILDING CODES, PERMITTING, INSPECTIONS	Yes/No	What type of codes? Are codes adequately enforced?
Building Codes	Yes	2006 IBC, IRC, IPC, IMC, IFC, 2005 National electric code, 1999, City Code.
C		Yes
Site plan review requirements	Yes	Planning and Zoning Ordinance.
		Yes
LAND USE PLANNING & ORDINANCES		Is the ordinance effective for reducing hazard impacts?
		Is the ordinance adequately administered and enforced?
Floodplain ordinance	Yes	Yes, Yes
Subdivision ordinance	Yes	Yes, Yes
Zoning ordinance	Yes	Yes, Yes
	ADMI	NISTRATIVE and TECHNICAL
ADMINISTRATION	Yes/No	Describe capability.
ADMINISTRATION	1 68/110	Is coordination effective?
Mutual aid agreements	Yes	Provide assistance to local agencies.
		Yes
Planning Commission	Yes	Voting and public input.
		Yes
	Yes/No	Is staff trained on hazards and mitigation?
TECHNICAL STAFF	FT/PT	Is coordination between agencies and staff effective?
	1 1/1 1	Have skills/expertise been used to assess/mitigate risk in the past?
Building Official	FT	Yes; Yes; Yes
Community Planner	FT	Yes; Yes; Yes
Emergency Manager	FT	Yes; Yes; Yes
Engineer	FT	Yes; Yes; Yes
Floodplain Manager/Administrator	Yes	Yes; Yes; Yes



GIS/HAZUS Coordinator	No	
Grant writer	No	
		FINANCIAL
FINANCIAL	Yes/No	Has the funding resource been used in past and for what type of activities?
THANCIAL	1 65/110	Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Yes*	Yes, capital needs of the city, primarily Airport.
		Yes with council approval
Community Development Block Grant	Yes	Yes, various community needs; no, usually the funding cycle is every 4 years and funds are specifically allocated from the beginning of the cycle
Authority to levy taxes for specific purposes	Yes*	Yes, to pay off existing bond debt; with council approval and direction
Impact fees for new development	No	
Incur debt through special tax bond	Yes*	Yes, to construct city facilities; yes, with council direction
Incur debt through general obligation bonds	No	
	EDU	UCATION and OUTREACH
PROGRAM / ORGANIZATION	Access / Eligibility	Describe program/organization and how it relates to disaster resilience and mitigation.
	(Yes/No)	Could the program/organization help implement future mitigation activities?
Firewise Communities certification	No	
Storm Ready certification	No	
Citizen groups focused on emergency preparedness, environmental protection, etc.	No	
Public education/information programs (fire	Yes	Fire and life safety education, fire extinguisher training, Emergency preparedness.
safety, household preparedness, responsible water use, etc)		Yes.
Public-private partnership initiatives addressing disaster-related issues	No	



Table 5-5: Capability Assessment for Tusayan

PLANNING and REGULATORY			
PLANS	Yes/No Year	Does the plan address hazards? Does the plan ID projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?	
Capital Improvements Plan	Yes	Yes to all 3 questions. Capital Improvements budget that addresses drainage and street improvements, as well as monies to assist with grant for wildfire mitigation.	
Community Wildfire Protection Plan	Yes, 2014	Yes to all 3 questions. Tusayan Fire District.	
Comprehensive/Master Plan	Yes, 2014	Yes to all 3 questions. The Town adopted a General Plan in 2014	
Continuity of Operations Plan	No		
Economic Development Plan	No	Policies noted in General Plan	
Emergency Operations Plan	Yes	Yes to all 3 questions. Included within the current Coconino Co Emergency Operations Plan	
Stormwater Management Plan	Yes	Yes to all 3 questions. Included within the current Coconino Co and the Grand Canyon National Park Airport operated by ADOT has a storm water management plan unique to the airport facility.	
Transportation Plan	Yes/No	General Plan has a transportation element which can be used to aid in mitigation actions, but no plan to address specific hazards .	
BUILDING CODES, PERMITTING, INSPECTIONS	Yes/No	What type of codes? Are codes adequately enforced?	
Building Codes	Yes	Yes to all 3 questions. Current application of IBC 2006, and in the process of updating to the 2012 IBC's.	
Site plan review requirements	Yes	Yes to all three questions. Willdan & Woodson Engineering Firms fulfill these needs.	
LAND USE PLANNING & ORDINANCES		Is the ordinance effective for reducing hazard impacts?	
		Is the ordinance adequately administered and enforced?	
Floodplain ordinance	Yes	Tusayan is included in the Coconino County ordinance of 2013.	
Subdivision ordinance	No	Tusayan is in the process of adopting a subdivision ordinance unique to Tusayan.	
Zoning ordinance	Yes	Adopted in 12-5-2012 and in process of updating	

How can capabilities be expanded and improved to reduce risk? Town staff will identify areas within their regulations to increase a greater level of enforcement and to implement projects and practices to reduce risks for hazards.





ADMINISTRATIVE and TECHNICAL			
A DAMINICED A THON	V /NI .	Describe capability.	
ADMINISTRATION	Yes/No	Is coordination effective?	
Mutual aid agreements	Yes	Coconino County, Kaibab National Forest, National Park Service, and Guardian will supplement response and resource needs during time of emergencies.	
Planning Commission	Yes	Planning Commission established in 2012 with Zoning Ordinance	
	Yes/No	Is staff trained on hazards and mitigation?	
TECHNICAL STAFF		Is coordination between agencies and staff effective?	
	FT/PT	Have skills/expertise been used to assess/mitigate risk in the past?	
Building Official	Yes	Yes to all 3 questions. Willdan performs building services	
Community Planner	Yes	Yes to all 3 questions Willdan performs planning functions	
Emergency Manager	Yes	Yes to all 3 questions Tusayan Fire District Chief performs as Emergency Manager.	
Engineer	Yes	Yes to all 3 questions Woodson Engineering	
Floodplain Manager/Administrator	Yes	Yes to all 3 questions. Tusayan included within Coconino County agreement.	
GIS/HAZUS Coordinator	Yes	Yes to all 3 questions included within Coconino County agreement.	
Grant writer	Yes	Yes to all 3 questions Town Manager and Clerk perform grant writing functions	
How can canabilities be expanded and improved to reduce risk? Making ampleyees givers of the town's Hazard Mitigation Plan and taking advantage			

How can capabilities be expanded and improved to reduce risk? Making employees aware of the town's Hazard Mitigation Plan and taking advantage of County and State training. Keeping CERT team concept alive to assist community with any hazard.

FINANCIAL			
FINANCIAL	Yes/No	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?	
Capital improvements project funding	Yes	Yes to both questions. Town does have a capital improvements budget	
Community Development Block Grant	Yes	Yes to both questions. Town does participate with CDBG program and is currently making improvements at the park for ADA parking and a restroom facility.	
Authority to levy taxes for specific purposes	Yes	Yes to both questions. Town has ability to adjust local sales tax levy for specific needs, and is currently allocating funds to assist the Tusayan Fire District operations.	
Impact fees for new development	No		
Incur debt through special tax bond	No		
Incur debt through general obligation bonds	No		
How can capabilities be expanded and improved to reduce risk? Continue to identify and budget for specific improvements listed in the Hazard			





Mitigation Plan as well as those identified by the community in future planning efforts.

EDUCATION and OUTREACH				
PROGRAM / ORGANIZATION	Access / Eligibility (Yes/No)	Describe program/organization and how it relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?		
Firewise Communities certification	No			
Storm Ready certification	Yes	Coconino County EOP and participant in NFIP. Yes will aid in future mitigation activity.		
Citizen groups focused on emergency preparedness, environmental protection, etc.	No			
Public education/information programs (fire safety, household preparedness, responsible water use, etc)	Yes	Tusayan Fire District performs community outreach with the schools, pre-school education and works with businesses/community groups and with entities County EOP		
Public-private partnership initiatives addressing disaster-related issues	Yes	Communications have been improved with updated radios and equipment, community wide training and exercises, such as table top exercises		

How can capabilities be expanded and improved to reduce risk? Participating in the Update of the Hazard Mitigation Plan has helped identify areas where the Tusayan community can improve safety and mitigate possible hazards. This will aid in identifying specific projects and areas. Exercise and training will enhance partnerships, support and coordination and involvement with local resources (local state and federal).

Table 5-6: Capability Assessment for Williams PLANNING and REGULATORY				
Capital Improvements Plan	Yes/ 2008	Yes, yes, yes		
Community Wildfire Protection Plan	Yes	WFAC		
Comprehensive/Master Plan	Yes/ 2009	Yes, no, yes		
Continuity of Operations Plan	NO			
Economic Development Plan	Yes/ 2013	No, no, Yes		



Emergency Operations Plan		Coconino County						
Stormwater Management Plan	Yes/ 2009	Yes, no, yes						
Transportation Plan	Yes/ 2008	Yes, no, yes						
BUILDING CODES, PERMITTING,	Yes/No	What type of codes?						
INSPECTIONS		Are codes adequately enforced?						
Building Codes	Yes	2008, IBC, IRC, NEC, IFC, Yes						
Site plan review requirements	Yes							
LAND USE PLANNING & ORDINANCES		Is the ordinance effective for reducing hazard impacts?						
		Is the ordinance adequately administered and enforced?						
Floodplain ordinance	Yes 2008	Yes, Yes						
Subdivision ordinance	Yes 2008	Yes, Yes						
Zoning ordinance	Yes 2008	Yes, Yes						
	ADMINISTRATIVE and TECHNICAL							
ADMINISTRATION	Yes/No	Describe capability.						
ADMINISTRATION		Is coordination effective?						
Mutual aid agreements	Yes	Communications, Inner OP, DPS, SO (EOC), Yes						
Planning Commission	Yes	Implement new ordinances, yes						
	Yes/No FT/PT	Is staff trained on hazards and mitigation?						
TECHNICAL STAFF		Is coordination between agencies and staff effective?						
		Have skills/expertise been used to assess/mitigate risk in the past?						
Building Official	Yes, FT	Yes, Yes, Yes						
Community Planner	Yes, FT	Yes, Yes, Yes						
Emergency Manager	Yes, FT	Yes, Yes, Yes						
Engineer	Yes,	Off Site						
Floodplain Manager/Administrator	Yes, FT	Yes, Yes, Yes						
GIS/HAZUS Coordinator	No							
Grant writer	Yes/ No	WPD, not the city						



FINANCIAL	Yes/No	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Yes	Yes, Flood mitigation
Community Development Block Grant	Yes	Water infrastructure, Housing,
Authority to levy taxes for specific purposes	No	
Impact fees for new development	No	
Incur debt through special tax bond	No	
Incur debt through general obligation bonds	No	

How can capabilities be expanded and improved to reduce risk? Increase of city financial resources, IGA's

EDUCATION and OUTREACH							
PROGRAM / ORGANIZATION	Access / Eligibility (Yes/No)	Describe program/organization and how it relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?					
Firewise Communities certification	No						
StormReady certification	Yes	County Plan					
Citizen groups focused on emergency preparedness, environmental protection, etc.	No						
Public education/information programs (fire safety, household preparedness, responsible water use, etc)	Yes	Fliers, mailers, brochures					
Public-private partnership initiatives addressing disaster-related issues	Yes	PODS					
How can canabilities be expanded and improved to reduce risk? Partnering with outlying jurisdictions, public outreach and educational programs							

How can capabilities be expanded and improved to reduce risk? Partnering with outlying jurisdictions, public outreach and educational programs



5.4 Mitigation Actions and Projects

During the valid period of the previous Plan, many mitigation activities have been accomplished by the jurisdictions within Coconino County. Some of these activities were included in the previous Plan's Mitigation Strategy, some were not. The activities that were not represent important steps in community sustainability that warrant inclusion in this Plan. Some of these activities were initiated by or motivated by hazard events that happened after the previous Plan was approved. Those activities are as follows:





WICEIT-JURISDICTIONAL TIMERAND WITHOUT TEATY								
Table 5-7: Past Mitigation Activities (NOT included in previous Plan)								
Project Name	Project Description	Project Cost Completion Date	Funding Source	Responsible Department				
	Coconino County							
Engineering Studies	Post-fire hydrology, hydraulics, sediment transport, Cinder Lake storage capacity, and Master Drainage Plan development for the Schultz Fire and Flood Area	\$500,000 2011	Coconino Co Flood Control District, FEMA, USGS, ADEM	Coconino Co Public Works, Flood Control District				
Engineering	Engineering design of multiple watershed restoration and flood mitigation projects in the Schultz Fire and Flood Area	\$2M 2015	Coconino Co Flood Control District, FEMA, NRCS, FHWA, ADEM	Coconino Co Public Works, Flood Control District				
Copeland Ditch	Construction of a gabion-walled, concrete-lined channel from the east-side intersection of Copeland Lane and US 89, east to the USFS boundary	\$1.2M 2011	FHWA	Coconino Co Public Works, Flood Control District				
Twin Berms	Construction of two large berms downstream of multiple watersheds to contain post-fire runoff and protect the Cinder Lake Landfill and downstream communities such as Doney Park	\$325,000 2011	USFS	Coconino Co Public Works, Flood Control District				
Girl's Ranch Road Berm	Construction of a large berm downstream of the Lenox/Wupatki Trails Watershed to safely convey post-fire runoff and protect downstream communities such as Fernwood and Doney Park	\$300,000 2012	Coconino Co Flood Control District; Coconino Resource Advisory Council; USFS	Coconino Co Public Works and Flood Control District				
Lower Campbell Ditch	Construction of a gabion-walled, concrete-lined channel along the southern edge of the eastern half of Campbell Ave, to safely convey post-fire runoff from the Campbell Watershed	\$2M 2012	Coconino Co Flood Control District, FEMA, ADEM	Coconino Co Public Works, Flood Control District				
Rodeo Drive Re-profile	Re-profile Rodeo Drive to better contain post-fire runoff from the Campbell Watershed along Campbell Avenue and into the Lower Campbell Ditch	\$300,000 2012	Coconino Co Flood Control District, FEMA, ADEM	Coconino Co Public Works, Flood Control District				
Thames/Brandis Emergency Watershed Protection Project (On and Off-Forest)	Construction of watershed restoration (on-forest) and flood mitigation (off-forest) to safely convey post-fire runoff in the Thames/Brandis Watershed	\$3.8M 2013	Coconino Co Flood Control District, NRCS	Coconino Co Public Works, Flood Control District				
Lenox/Wupatki Emergency Watershed Protection Project (On and Off-Forest)	Construction of watershed restoration (on-forest) and flood mitigation (off-forest) to safely convey post-fire runoff in the Lenox/Wupatki Watershed	\$1M 2013	Coconino Co Flood Control District, NRCS	Coconino Co Public Works, Flood Control District				
Crisp Hill Box Culvert	Construction of a 400' long box culvert under Campbell Ave, connecting the completed Lower Campbell Ditch to the future Upper Campbell Ditch, and safely conveying post-fire runoff from the Campbell Watershed	\$1 M 2013	Coconino Co Flood Control District	Coconino Co Public Works, Flood Control District				





Table 5-7: Past Willig	Table 5-7: Past Mitigation Activities (NOT included in previous Plan)							
Project Name	Project Description	Project Cost Completion Date	Funding Source	Responsible Department				
Upper Campbell Ditch	Construction of a shotcrete-lined channel along the north side of the western half of Campbell Avenue, to safely convey post-fire runoff from the Campbell Watershed	\$1.2M 2013	Coconino Co Flood Control District, FEMA, ADEM	Coconino Co Public Works, Flood Control District				
Sunset Crater Estates Drainage Improvements	Construction of localized drainage improvements in the Sunset Crater Estates neighborhood of Doney Park, to improve safe conveyance of nuisance, and post-fire runoff flows	\$800,000 2013	Coconino Co Flood Control District, FEMA, ADEM	Coconino Co Public Works, Flood Control District				
Upper Campbell Emergency Watershed Protection Project (On and Off-Forest)	Construction of watershed restoration (on-forest) and flood mitigation (off-forest) to safely convey post-fire runoff in the Campbell Watershed	\$2.2M 2014	Coconino Co Flood Control District, NRCS	Coconino Co Public Works, Flood Control District				
Alice Drive Vented Ford	Construction of a vented ford (box culvert with low water crossing) completing the safe conveyance of post-fire runoff from the Campbell Watershed	\$450,000 2014	Coconino Co Flood Control District, FEMA	Coconino Co Public Works, Flood Control District				
North Paintbrush Emergency Watershed Protection Project (On and Off-Forest)	Construction of watershed restoration (on-forest) and flood mitigation (off-forest) to safely convey post-fire runoff in the North Paintbrush Watershed	\$2.9M 2014	Coconino Co Flood Control District, NRCS	Coconino Co Public Works, Flood Control District				
Paintbrush Lane North Side Individual Lot Mitigation	Construction of flood mitigation on severely impacted private properties (off-forest) to safely convey post-fire runoff in the North Paintbrush Watershed	\$260,000 2014	Coconino Co Flood Control District, NRCS	Coconino Co Public Works, Flood Control District				
Paintbrush Lane South Side Individual Lot Mitigation	Construction of flood mitigation on severely impacted private properties (off-forest) to safely convey post-fire runoff in the South Paintbrush Watershed	\$500,000 2014	Coconino Co Flood Control District, NRCS	Coconino Co Public Works, Flood Control District				
Pre-Monsoon Mitigation Preparations	Installation of 1 mile of concrete jersey barriers and 30,000 sandbags around more than 50 structures in Oak Creek Canyon to protect them from probable post-fire runoff	\$500,000 2014	Coconino Co Flood Control District, NRCS	Coconino Co Public Works, Flood Control District				
South Paintbrush Emergency Watershed Protection Project (On and Off-Forest)	Construction of watershed restoration (on-forest) and flood mitigation (off-forest) to safely convey post-fire runoff in the South Paintbrush Watershed	\$4.7M 2015	Coconino Co Flood Control District, NRCS	Coconino Co Public Works, Flood Control District				
South Paintbrush Individual Lot Mitigation (Off-Forest)	Construction of flood mitigation on severely impacted private properties (off-forest) to safely convey post-fire runoff in the South Paintbrush Watershed	\$76,000 2015	Coconino Co Flood Control District, NRCS	Coconino Co Public Works, Flood Control District				





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Table 5-7: Past Mitigation Activities (NOT included in previous Plan)							
Project Name	Project Description	Project Cost Completion Date	Funding Source	Responsible Department			
Lower Campbell Ditch Culvert Upsizing	Replacement of two smaller box culverts with appropriately sized culverts to convey peak flows thorough the Lower Campbell Ditch	\$620,000 2015	Coconino Co Flood Control District	Coconino Co Public Works, Flood Control District			
Copeland Detention Basins	Construction of two detention basins, three sediment traps, and roadside channel improvements to mitigate post-fire runoff from the Copeland and Peaceful Watersheds, to protect US 89, and to protect the regional landfill and downstream communities such as Doney Park	\$5.325M 2015	Coconino Co Flood Control District, FHWA, ADOT	Coconino Co Public Works, Flood Control District			
	Flagstaff						
Landfill Containment	Earthen barrier/dam built around the landfill to protect water supply during flooding	In-kind 2013	COF General Fund	COF Public Works			
Water Line replacement	Replaced the City of Flagstaff water line to the Inner Basin well field and made waterline and road flooding resistant	\$3.3M 2014	FEMA Grant	City of Flagstaff Grants Manager			
Skunk drainage J Diamond	Open storm channel to alleviate neighborhood flooding	\$300,000 2014	Storm water Utility Fee	COF Storm water			
Bundled Drip project	10 localized flooding problems mitigated	\$500,000 2014	Storm water Utility Fee	COF Storm water			
Cherry Neighborhood Storm drains	Storm drain improvements in the Cherry avenue neighborhood to improve drainage	\$400,000 2014	Storm water Utility Fee	COF Storm water			
Clay Avenue Retention Basin	Regional retention basin for excessive storm water	\$3M 2015	Storm water Utility Fee	COF Storm water/Army Corps of Engineers			
Linda Vista Rainer Project	Street reconstruction to improve drainage	\$250,000 2015	Storm water Utility Fee	COF Storm water			
No texting while driving	City ordinance passed to prohibit texting while driving	In-kind costs 2015	COF General Fund	City of Flagstaff			
Fredonia							
Dike repairs	Cleaned out the wash and the silt from the gateway on the dike.	\$4,000 Nov 2013	Public Works Budget	Public Works			
Page							
North Apron expansion	In 2010 Page Municipal airport completed a north apron expansion and relocation of the T hangers.	\$200,000 2010	FAA Grant	Public Works & Building			



Table 5-7: Past Mitigation Activities (NOT included in previous Plan)						
Project Name	Project Description		Funding Source	Responsible Department		
Coppermine Road & Haul Road Drainage Project	This project was to divert storm water away from roadways and businesses by increasing the capacity of the culverts and ditches.	\$175,000 2010	General Fund	Engineering		
New ARFF station	In 2011 a new ARFF station was opened at the Lake Powell Jet Center.	2011	Private	Building		
Golf Course Drainage Project	This project was designed and constructed to divert water around residences by installing culverts, inlet boxes and ditches	\$100,000 2011	General Fund	Engineering		
North apron pavement strengthening	In 2012 Page Municipal Airport completed the East side of north apron pavement strengthening.	\$1.9M 2012	FAA Grant	Public Works		
Airport Runway Overlay	In 2013 Page Municipal airport completed a runway overlay project.	\$1M 2013	ADOT and 10% City match	Public Works		
North apron pavement strengthening In 2014 Page Municipal Airport completed the west side of the north apron pavement strengthening.		\$1.2M 2014	FAA Grant	Public Works		
Highlands Fire District						
Bear Jaw Fuels Reduction	The Dept has performed fuel reduction projects including mechanical-hand thin, pile and burn; fire-broadcast burns; and mechanical chipping for the Fire Districts of Highlands, Pinewood and Summit. The estimated acres for this project are 1,010.	\$750,000 2009-2014	SFA & Fire District Budget	Highlands Fire District		



Previous Plan's Mitigation Strategy Assessment

The Planning Team reviewed and assessed the actions and projects (A/Ps) listed in the previous Plan. The assessment included evaluating and classifying each of the previous Plan's A/Ps as to progress and whether to delete, revise or keep it. Any A/P with a classification of "Keep" or "Revise" was updated and carried forward to become part of the Mitigation Strategy for this Plan. All A/Ps identified for deletion were removed and are no longer included in the Plan. The results of this assessment are located in this Plan's Appendix.

New Mitigation Strategy

Upon completion of the previous Plan's mitigation strategy assessment, each jurisdiction developed new A/Ps using the goal and objectives, results of the vulnerability analysis and capability assessment, and institutional knowledge of hazard mitigation needs in the community. For each A/P, the following elements were identified:

- Description
- Hazard(s) Mitigated
- Estimated Costs
- Anticipated Completion Date
- Lead Agency
- Potential Funding Source(s)

Each A/P was then assigned a priority ranking of either "High", "Medium", or "Low". The assignments were subjectively made using a simple process that assessed how well the A/P satisfied the following considerations:

- A favorable benefit versus cost evaluation, wherein the perceived direct and indirect benefits outweighed the project cost.
- A direct beneficial impact on the ability to protect life and/or property from hazards.
- A mitigation solution with a long-term effectiveness

The following tables summarize the current mitigation strategies for each participating jurisdiction.





Project Name	Hazard(s)	Estimated Cost & Completion	Project Lead	Potential Funding	D
Description	Mitigated HIGH	Date PRIORITY	Agency	Source(s)	Progress/Status
'Greater Flagstaff Forests Partnership' A community-based collaborative of environmental, business, land-management, emergency response, and regulatory agencies whose objectives include 1) Forest Restoration 2) Community Protection from wildfire 3) Sustainable, small-diameter wood utilization 4) Adaptive management. The focus involves a multi-jurisdiction area of 180,000 acres surrounding Flagstaff, but the area of interest extends well beyond that to include the nearly 900,000 acre area encompassed by the Greater Flagstaff Community Wildfire Protection Plan.	Wildfire	\$750/acre On-going	Greater Flagstaff Forests Partnership. Includes the 4FRI (Four Forest Restoration Initiative)	Various grants, Fire Adapted Communities Learning Network & contributions from City & County	To-date, over 60,000 acres of forest treatment has occurred.
'Flagstaff Fire Dept Wildland Fire Management Program' Housed within the Prevention Bureau, the staff lead and manage a program focused on 1) Prevention 2) Preparedness 3) Hazard Mitigation, 4) Response 5) Recovery. Efforts are centered on Education, Engineering, Enforcement and Ecosystem. The Flagstaff Wildland-Urban Interface Fire Code was adopted in 2008.	Wildfire	\$100,000 2020	Flagstaff Fire Dept	City general funds, some grant and donation contributions which include 26,000+ hrs of volunteer donated time since 2001.	'Flagstaff Fire Dept Wildland Fire Management Program'. Housed w/i the Prevention Bureau, the staff lead and manage a program focused on Prevention, Preparedness, Hazard Mitigation, Response & Recovery. Efforts are centered on Education, Engineering, Enforcement and Ecosystem. The Flagstaff Wildland-Urban Interface Fire Code was adopted in 2008.
Floodplain re-mapping, including any local requests for map updates to provide the community with a regulatory tool to reduce the losses to property and people for Munds Park and Kachina/Mountainaire.	Flood	\$100,000 2016	Co PW/ Flood Control District/ Co Engineer	Flood District/General Funds	Floodplain re-mapping, including any local requests for map updates to provide the community with a regulatory tool to reduce the losses to property and people for Ft. Valley; Doney Park; Munds Park.





Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	Progress/Status
Develop neighborhood wildfire assessment and rank at-risk neighborhoods with the goal to provide accurate wildfire information to residents and motivate them to implement personal and neighborhood mitigation measures	Wildfire	\$150,000 On-going	WFAC/ PFAC	General Funds/ Health Forest Initiative Funds (AZ)	Develop neighborhood wildfire assessment and rank at-risk neighborhoods with the goal to provide accurate wildfire information to residents and motivate them to implement personal and neighborhood mitigation measures
Conduct roadside thinning along Forest Highway 3 (Lake Mary Road), Perkinsville Rd, Old Munds Hwy, Garland Prairie, and Spring Valley Rd to reduce vulnerability to the effects of wildfire	Wildfire	\$778,182 2017	Public Works / Co Engineer	HURF Funds	
Enforcement of floodplain management requirements in accordance with the NFIP, including regulating all and substantially improved construction in floodplains to reduce the losses to property and people.	Flood	Staff Time Ongoing	Co Engineer Community Development	General Funds/Flood District	
Develop additional GIS data layers including Sedona and Winona areas to facilitate future revisions of the greater Flagstaff area Community Wildfire Protection Plan	Wildfire	\$25,000 2020	Greater Flagstaff Forest Partnership/ PFAC	CCPW/ USFS grants	
	MEDIUN	M PRIORITY			
'Rural Communities Fuel Management Partnerships' An informal multi-agency alliance has been created to work with landowners to reduce fuel hazards on their property in two communities located in Coconino Co. Initial complementary work was conducted on the Kaibab Nat'l Forest adjacent to the communities of Sherwood Forest Estates and Parks. Additional grant funds are continually being sought to continue the fuels reduction work on private property in other local communities including Doney Park and Williams. The Blue Ridge community is now included as well.	Wildfire	\$200,000 2020	Kaibab Nat'l Forest, AZ State Land Dept, U of A Coconino Co Cooperative Extension, Coconino Co, fire districts in Coconino Co	Grant – Unspecified (grants obtained through State Forestry are administered to Coconino Co for distribution)	Project continuation is pending additional grant funding.
Establish and maintain a county component of the state GIS mapping system documenting forest treatments, hazard data, grants, etc.	All	\$50,000 2020	Co EM	State grants/PDM	



Commodity Flow Study for State Hwy 89 from Utah Boundary to Flagstaff

announcements, public access TV, website



Table 5-8: Mitigation Strategy for Coconino County									
Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	Progress/Status				
Winter Weather Preparedness Campaign/ Brochures developed for Public/PSA/Webpage Input	Winter Storm	\$2,000/ Staff Time on-going	Co EM/ Co PW	Hazard mitigation grant funds, operating budget	On-going indefinitely.				
LOW PRIORITY									
Educational programs and outreach to outlying areas of the county that are not currently served by any organized fire protection system with the goal to assist in organizing districts	Wildfire	\$20,000 On-going	All fire agencies	General Funds/ PFAC donations					
Flash Flood Early Warning System for hikers in Havasupai Canyon to alert campers of life threatening event in canyon- Feasibility Study and Implementation	Flood	\$200,000 2020	Co EM/ ADEM/NWS/ Tribal EM	PDM/ HUD/EMPG Funds					
Expand education activities to include N AZ Home Show, public service	Δ11	\$35,000	Co.EM	EMPG/General					

On-going

\$100,000

2020

All

HazMat

Co EM

Co EM/ AZSERC

Funds/ title III

Grant/Homeland

Security Grants

HMEP

Table 5-9: Mitigation Strategy for Flagstaff									
Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	Progress/Status				
HIGH PRIORITY									
Red Gap Ranch Study. A study is underway to evaluate the future pumping for Red Gap Ranch and potential impacts on regional stream depletion rates.		\$150,000 2020	Flagstaff Utilities Div.	USBR grant					



Table 5-9: Mitigation Strategy for Flagstaff

Table 3-7. Wingation Strategy for Flagstair					
Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	Progress/Status
Flagstaff Well Field & Pipeline Evaluation. The City purchased Red Gap Ranch and has drilled 10 wells for the purpose of future water supply. The City is currently negotiating a Right of Water with ADOT along 1-40 and is performing the first phase of a feasibility study.	Drought and Wildfire	\$12M On-going	Flagstaff Utilities Div.	Utility rates	
Flagstaff Watershed Protection Project. Also referred to as Lake Mary & Dry Hills Watershed Protection Project. Approved by the voters, this project is being pursued to ensure the viability of this surface reservoir and stormwater runoff through forest treatments.	Drought and Wildfire	\$500,000 On-going	Flagstaff Fire & Utilities Div.	Tax & Utility rates	
Upgrade existing conservation measures to provide for water during periods of drought. Flagstaff depends on surface reservoirs and groundwater for domestic water supply. Conservation efforts expand the capacity of this limited resource.	Drought	\$250,000 On-going	Water Utilities Dept/ Conservation Manager	City of Flagstaff bonds, annual budget	The Flagstaff Watershed Protection Project is underway, reclaimed water is required for large area irrigation and lawn watering restrictions are in place. A water harvesting rebate program was started in July 2012. Water conservation outreach was presented to all students at the fourth grade level.
Enhance flood mitigation efforts through channelization and detention. Due to drainage patterns and topography many areas of the city are subject to periodic flooding during snow melts and monsoon periods.	Flood	\$5.4M 2025	Storm Water Manager	City of Flagstaff stormwater utility fee	The Clay Avenue Wash Basin flood mitigation dam was completed. The Linda Vista/Rainer Street and drainage project was completed.
Plan and conduct forest treatments to reduce severity and impact of unwanted wildfire both within and adjacent to the community. The Flagstaff are is ranked as the #1 wildfire threatened are in AZ.	Wildfire	\$10M bond + \$350,000 city On-going	Fire Dept /Wildland Fire Mgmt Officer	Bond funding, federal through state grants	Hazard Mitigation activities (selective thinning, debris disposal, prescribed fire, hazard trees). Involves internal city stand-alone efforts as well as collaborative efforts with our partners (Ex: Four Forest Restoration Project, Greater Flagstaff Forests Partnership).
Provide equipment and human resources sufficient to handle comprehensive road, air, and railway hazmat and mass casualty incidents. Nearly 120 trains travel through the Flagstaff boundaries each day. I-40 and I-17 generate truck traffic that carry hazardous materials through the city each day.	HazMat Transportati on Accidents	\$250,000 On-going	Fire Dept /Training Chief	General taxation, S.A.R.A. titled funds	Flagstaff FD continues to train, equip, and respond to transportation and fixed site emergencies throughout Northern Arizona.





Table 5-9:	Mitigation	Strategy	for F	lagstaff
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Table 5-9: Midgation Strategy for Flagstan					
Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	Progress/Status
Educate the local and regional community (including tourists) about the potential and consequences of catastrophic wildfire and actions necessary to mitigate the risk/threat.	Wildfire	\$50,000 On-going	Fire Dept/ Firewise Coordinator	General taxation	Firewise Neighborhood and Fire-Adapted-Community programs, Annual Restrictions & Closure Plan, Annual Wildfire Preparedness Day, Flagstaff Wildland-Urban Interface Fire Code, general outreach efforts and events.
The Rio DeFlag Project is a major flood control initiative designed to remove 1500 structures from the flood plain. The downtown area is prone to flooding and this effort will reduce the flood threat and enable further economic development in this area.	Flood	\$30M 2020	Capital Improvements/ Rio DeFlag Project Mgr	Federal grants	The design phase is ongoing with coordination from the Army Corps of Engineers, but funding has not been secured yet.
Install generators for water wells vulnerable to losing power during wildfires. More than 60% of the water supply is pumped from underground wells. Many of these well fields are subject to wildfire threats that disrupt power.	Wildfire	\$2.5M On-going	Water Utilities/ Division Head	Operating capital	The generator project for the Tuthill well is out to bid. A mobile unit is available for deployment to be used at the Shop well. The Woody Mountain well and Lake Mary well will be next to upgrade with back- up generators.
		MEDIUM PI	RIORITY		
Fire Prevention Patrols. Fire prevention patrols by Law Enforcement including flyovers to discover illegal transient camps and illegal fires within the City limits.	Wildfire	\$10,000/yr On-going	Flagstaff Police Dept	Annual Budget	
Pulliam Airport Security Screening. Armed police officers are present at airport screenings prior to boarding to ensure passenger safety.	HazMat, Transportati on Accidents	\$80,000/yr On-going	Flagstaff Fire Dept	Transportation Safety Authority Grant	
Clay Avenue Wash Detention (Dam) Basin Emergency Action Plan. A plan to address how to warn the public in the event of a pending dam failure or flooding.	Dam Failure, Earthquake, Flood, Winter	In-kind 2016	Storm Water	Annual Budget	



Table 5-9: Mitigation Strategy for Flagstaff

Project Name Description	Hazard(s) Mitigated Storm	Estimated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	Progress/Status
Construct & equip a multi-agency EOC to coordinate disasters. The area is subject to periodic disasters. On an annual basis the EOC is activated 2-3 times each year.	All	\$2M When funding becomes available	Fire Dept/ Fire Chief		The alternate Emergency Operations Center (EOC) is currently under construction,
Floodplain identification and mapping, including any local requests for map updates to provide the community with a regulatory tool to reduce the losses to property and people.	Flood	\$100,000 2016	Storm Water/ Storm Water Manager	City of Flagstaff stormwater utility fee	All Flood Insurance Rate Maps (FIRM) have been updated and converted to Digital Flood Insurance Rate Maps (D-FIRM), to help enforce flood plain regulations. We completed the Northeast area Master Drainage Study, a master plan to conceptually identify and mitigate major flooding in Northeast Flagstaff.

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Table 5-10:	MHU2auon	Strategy	101 1	rreuoma	

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Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Lead Agency for Project	Potential Funding Source(s)	Progress/Status				
HIGH PRIORITY									
Replacing existing dike to a levy.	Dam Failure	\$67,000,000 2018	Public works	Grants					
Replace existing backwash basin at the water ponds. Repair pumps in the wells.	Drought	\$225,000 for design (5/2015) \$10,000 (2016)	Public works	Grants (WIFA) enterprise funds					





Table 5-10: Mitigation Strategy for Fredonia

Duoicat Nama	Hogawd(s)	Estimated Cost &	Load Aganay for	Detential Funding	
Project Name Description	Hazard(s) Mitigated	Completion Date	Lead Agency for Project	Potential Funding Source(s)	Progress/Status
Hold annual community meeting in September with all residents and churches to educate residents about 72 hour kits and food storage.	Winter Storm	\$500 Annually, On going	Town Manager and Marshall	General Fund	
	MEDIU	UM PRIORITY			
Conduct Fire Department Training for a hazardous fires and spills.	HazMat	\$1,000 Every couple of years starting with 2016	Fire chief	General Fund	
Conduct severe wind community outreach through newsletter in the spring and fall, reminding residents to put outdoor belongings away.	Severe Wind	\$400 On going	Town Clerk	General Fund	
Enforce speed limits and training.	Transportation Accidents	\$5,000 On going	Marshall's office	General Fund	
Fire Department training, community outreach (through annual community meeting, with specifics being prepared).	Wildfire	\$1,000 On going	Fire Chief, Town Clerk	General Fund	
	LOV	V PRIORITY			
Outreach to the community, quarterly, through the town discussing what to do in the event of an earthquake.	Earthquake	\$400 On going	Marshall's and Town Clerk	General Fund	
Conduct feasibility study for curb and gutters to determine cost.	Flood	\$5,000 2018	Public Works, Town Manager	Grants HURF	





Table 5-11: Mitigation Strategy for Page					
Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	Progress/Status
	HIGH PRIO	RITY			
Provide equipment and other resources sufficient to provide initial response to major road, air, hazardous materials and mass casualty incidents.	HazMat Transportation Accidents, Winter Storm, Flooding Severe Wind	\$150,000 On going	Fire Department	General Fund	Page FD continues to train, equip., and respond to transportation and fixed site emergencies throughout Northern Arizona.
	MEDIUM PRI	ORITY			
The City will develop a plan and mutual aid agreement with the State, County, Navajo Nation, National Park Service and other governmental entities as necessary to implement mitigation actions.	Flooding, HazMat, Winter Storm, Severe Wind, Transportation Accidents	\$100,000 2016	Community Development/ Building Official	General Fund	40% Complete
Page Fire Dept. will develop a public awareness program. Handouts and presentations will be developed and presented at area clubs, schools, and other public gatherings. Goals of the project shall include increasing public support for funding disaster preparation, educating the public what to do in case of a disaster, and increasing public awareness as to how public safety agencies will respond in a disaster	Drought, Flooding Winter Storm, Severe Wind	\$15,000 On going	Fire Department	General Fund	In progress
Design and construct drainage structures for problem flood areas throughout the city to prevent flooding of properties and buildings.	Flooding	\$2,000,000 2018	Engineering/Public Works		In progress
Water supply system upgrade. This project is to upgrade the current pumping units and possibly identify an alternative lower level intake with a new pumping system and a separate pipeline to deliver water to the water treatment plant. This will allow for dependability and a backup to the current system. It will also provide water if the lake level drops below the current intake levels.	Drought	\$5,000,000 2019	Engineering & Utility Department/ City Engineer		No progress





Construction mitigation from drainage study for (LOMR). Construct any channels, berms, bank stabilization, etc. which arise from the drainage study.	Flooding	\$2,500,000 2019	Engineering Department/ City Engineer		In progress				
LOW PRIORITY									
The City will develop a plan and pamphlets and implement a public information program that will identify the following: Who can apply? What types of emergencies can be applied for? Where to apply.	Drought, Flood, Winter Storm, Severe Wind	\$100,000 2017	Risk Mgmt, Human Resources, Public Information Officer	General Fund	In progress				

Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Lead Agency	Funding Source(s)	Progress/Status
	HIGH PRIC	ORITY			
Perform Initial Engineering Assessment and Hydrologic Analysis, coordinate with County for drainage improvements work plan and perform various projects identified in this plan.	Flood	\$75,000 - \$100,000 On-going	Town Administration	General Fund	
Partner with Coconino County in use of CODE RED emergency alert system to improve warning and evacuation systems during Hazmat incidents.	HazMat	\$1,500 On-going	Town Admin. and Sheriff's Office	General Fund	
Support Tusayan Fire District in wildfire mitigation activities through Reduction of Hazardous Fuels Grant program.	Wildfire	\$200,000 Jan. 2017	Tusayan Fire, Kaibab NF, and AZ State Forestry	Wild land Hazardous Fuels Grant & General Fund	
	MEDIUM PR	IORITY			
Promote and enforce water conservation through cooperative programs with water company.	Drought	\$2,500 On-going	Town Administration	General Fund	





Table 5-12: Mitigation Strategy for Tusayan

Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Lead Agency	Funding Source(s)	Progress/Status
Work with ADOT to replace and add signage along Highway 64, including crosswalk blinker signs for pedestrian safety.	Transportati on Accidents	\$25,000 On-going	Maintenance Division	HURF	
Implement plan for snow removal throughout the town, including for severe storms. Maintain snow removal equipment and have list of contractors available for severe incidents.	Winter Storm	\$5,000 On-going	Maintenance Division	HURF and General Fund	
	LOW PRIO	RITY			
Educate public with links and/or information available from the Arizona Geological Survey.	Earthquake	\$2,500 On-going	Town Administration	General Fund	
Assist with educating the public about impacts associated with severe wind hazard in this region.	Severe Wind	\$2,500 On-going	Town Admin and Sheriff Office	General Fund	

Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Lead Agency for Project	Potential Funding Source(s)	Progress/Status
Perform public outreach and education campaign with informational booklets from the AZ Geological Survey.	Earthquake	On-going	Williams Police/ Fire Public Works Director	General Fund	In progress
Partnering with Coconino Co in use of CODE RED emergency alert system to better warn and evacuate citizens during HazMat events.	HAZMAT	On-going	Williams Police/ Fire	General Fund	In progress



Table 5-13: Mitigation Strategy for Williams

Tuble 5 10. Willigation Strategy for Williams	F	T	T-	F	Г
Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Lead Agency for Project	Potential Funding Source(s)	Progress/Status
Working with NACOG to update, replace and add signage on the roads in Williams that meet current standards, add reflectivity and increase driver awareness.	Transportation Accidents	On-going	Williams Police/ Fire/ Public Works/Streets	General Fund/ NACOG	In progress
Enforcement of floodplain management requirements, including regulating all and substantially improved construction in floodplains to reduce the losses to property and people.	Flood	Staff Time On-going	Planning and Building Code Enforcement/ Building Official	General Fund	In Process Implementation through building codes
Continue to enforce zoning and building codes through current site plan, subdivision, and building permit review processes to reduce the effects of drought, flood, severe wind, wildfire, and other hazards on new buildings and infrastructure.	Drought, Flood, Severe Wind, Wildfire	On-going	Planning and Building Code Enforcement/ Building Official	General Fund	In Process Implementation through building codes
Perform fuel thinning around water treatment plant to create a wildfire defensible space perimeter, and install exterior sprinkler system on the structures and site perimeter.	Wildfire	\$285,000 2020	Public Works/ Director	General Fund	In Progress Thinning is complete, sprinklers complete in FY16/17
Annual Inspections and Maintenance work on five existing city dams. Continued monitoring by the City Water Department in cooperation with ADEQ.	Dam Failure	\$100,000 On-going	Public Works/ Director	General Fund	In Process
Continued planning as part of the annual Snow Removal Plan. This planning effort continues every year in advance of the winter season and includes inventorying and maintenance of existing snow removal vehicles, plows, cutting edges, chains, and other equipment. The City also contacts local contractors to identify resources in the event of a major snow storm.	Winter Storm	\$100,000 On-going	Public Works/ Director	General Fund	In Progress
Continued tree and shrub pruning around power lines, telephone lines, and other infrastructure as part of regular Town maintenance.	Winter Storm	\$300,000 On-going	Public Works/ Director	General Fund	In Progress
Enforcement of the newly adopted Defensible Space Ordinance for the protection of future and existing structures within the wildland urban interface.	Wildfire	\$25,000 On-going	Planning and Building Code Enforcement/ Building Official	General Fund	In Progress implementation through

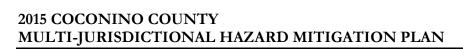




Table 5-13: Mitigation Strategy for Williams

Project Name Description	Hazard(s) Mitigated	Estimated Cost & Completion Date	Lead Agency for Project	Potential Funding Source(s)	Progress/Status
					building codes
Perform public outreach activities, including fliers, town hall meetings, safety fairs, and others to educate the public on wildfire protection activities and best management practices.	Wildfire	\$5,000 On-going	Public Works/ Director	General Fund	In Progress
Create new storage facilities for effluent to be used for irrigation and emergency wildfire protection.	Wildfire	\$50,000 2020	Public Works/ Director	General Fund	In Progress Creating additional effluent storage at WWTP by rehabilitating old wasting lagoons. \$100,000 FY15/16



SECTION 6: PLAN MAINTENANCE PROCEDURES

Elements of this section include:

Monitoring, Evaluating and Updating the Plan

Incorporation into Existing Plans and Procedures

Continued Public Participation

Although formal annual evaluations were not completed every year, it was indirectly reviewed on a frequent basis. Plan was used in or as a reference to several other planning mechanisms, as illustrated in Section 6.3. The lack of review was primarily due to:

- The plan maintenance requirements were not effectively communicated when changes in personnel occurred.
- A general lack of understanding regarding the importance and requirements of the maintenance element.
- A period of several significant hazard events and heavy mitigation efforts, resulting in the lack of resources or time to perform the plan maintenance tasks.

Recognizing the need for improvement, the Planning Team discussed ways to make sure that the Plan review and maintenance process will occur over the next five years. The results of those discussions are outlined in the following sections and the plan maintenance strategy.

6.1 Monitoring, Evaluating and Updating

The Planning Team has established the following monitoring and evaluation procedures:

- Schedule The Plan shall be reviewed on at least an annual basis or following a major disaster. Coconino County will take the lead to coordinate with the Planning Team on or around the anniversary of the Plan approval and work out a suitable reporting format for the evaluation results. ADEM will also help with reminders to the County as a double accountability. Copies of the annual review report are in this Plan's Appendix.
- **Review Content** A reminder questionnaire will be distributed to each jurisdictions' Point of Contact, with the following questions:
 - *Hazard Identification:* Have the risks and hazards changed?
 - Goals and objectives: Are the goals and objectives still able to address current and expected conditions?
 - Mitigation Projects and Actions: Has the project been completed? If not complete but started, what percent of the project has been completed? How much money has been expended on incomplete projects? Did the project require additional funds over the expected amount or were the costs less than expected?

During the Plan evaluation, each Point of Contact will have the opportunity to provide a report to the group of his/her review of the Plan. The report will include their responses to the above questions and any other items specific to their community. Documentation of the annual meeting will include notes on the results of the meeting as well as more specific information on the reasoning behind proposed changes to the Plan.

A formal presentation of the review material will be presented to a jurisdiction's council or board only if a major update to the Plan is proposed prior to the next five year update.



The Plan requires updating and approval from FEMA every five years. The plan update will adhere to that set schedule using the following procedure:

- One year prior to the plan expiration date, the Planning Team will re-convene to review and assess the Plan and annual evaluation results.
- The Planning Team will update and/or revise the appropriate or affected portions of the plan and produce a revised plan document.
- The revised plan document will be presented before the respective councils and boards for an official concurrence, if necessary.
- The revised plan will be submitted to ADEM and FEMA for review, comment and approval.
- When FEMA has approved and determined the Plan approvable, the participating jurisdictions will officially adopt the Plan and submit resolutions to FEMA.

6.2 Incorporation into Other Planning Mechanisms

Incorporation of the Plan into other planning mechanisms, either by content or reference, can enhance a community's ability to perform hazard mitigation by expanding the scope of the Plan's influence. Some of the ways the 2010Plan was incorporated or referenced into other planning mechanisms and will continue to be, where appropriate, are as follows:

- The County and incorporated Flagstaff, Page and Williams embarked on a Multi-Jurisdictional Emergency Operations Plan. That plan, similar to the Hazard Mitigation Plan became an all-hazard plan and utilized similar concepts as we employed during the past planning process.
- Used in developing Capital Improvement Projects through County Engineering for the County's CIP and prioritizing those efforts.
- Referenced in the development of the County COOP plan, Hazmat Response Plan and Annex, and the Public Health emergency Preparedness Plan.
- Some of the 2010 Plan is being used in the Coconino Co Comprehensive Community Planning process which began in 2009.
- The Plan findings were used in the City's Continuity of Operation Plans (COOP) and the City's Pandemic planning efforts.
- The 2010 Plan was used in development of the Page Unified School District Emergency Operations Plan.
- The Plan was reviewed and referenced on an annual basis by city staff during emergency preparedness planning meetings for the wildfire and snow/winter seasons as well as a resource for developing building codes that required clear space for wildfire mitigation.

Typical ways to use and incorporate the Plan over the next five-year planning cycle, discussed by the Planning Team, included:

- Use of, or reference to, Plan elements in updates to general and comprehensive planning documents.
- Addition of defined mitigation measures to capital improvement programming.
- Inclusion of Plan elements into development planning and practices.
- Resource for developing and/or updating emergency operations plans.



The Plan may also serve as a reference for other mitigation and land planning needs of the participating jurisdictions. Whenever possible, each jurisdiction will endeavor to incorporate the risk assessment results and mitigation measures identified in the Plan, into existing and future planning mechanisms. At a minimum, each of the responsible agencies/departments will review and reference the Plan and revise and/or update the legal and regulatory planning documents, manuals, codes, and ordinances summarized, as appropriate. Specific incorporation of the Plan risk assessment elements into the natural resources and safety elements of the jurisdictions' general plans and development review processes, adding or revising building codes, adding or changing zoning and subdivision ordinances, and incorporating mitigation goals and strategies into general and/or comprehensive plans, will help to ensure hazard mitigated future development.

6.3 Continued Public and Stakeholder Involvement

The participating jurisdictions are committed to keeping the public informed about their community's risk, hazard mitigation planning efforts, actions and projects. In order to accomplish this, the Planning Team shall pursue the following opportunities for public involvement and dissemination of information whenever possible and appropriate:

- Provide a permanent webpage on the County's website that will house a digital copy of the Plan and document future planning activities WITH Contact information for the County.
- Coconino County Office of Emergency Management participates in annual events such as the County Fair, other public events, and public outreach. They manage a booth at the annual Home Show providing information on emergency preparedness and hazard awareness as well as a booth at the County Fair.
- Perform public outreach and mitigation training meetings for targeted populations known to be in higher risk hazard areas (i.e. – floodplain residents). The County conducts community outreach in many forms. Website information, fairs, neighborhood watch group meetings, service organizations, NGOs. Date and times are scheduled on an as-needed basis using available staff. The County has a variety of brochures and site bulletins for distribution at most of the government agency buildings and other public locations.

Furthermore, the incorporated communities within Coconino County currently perform or will pursue the following opportunities for public involvement and dissemination of information whenever possible and appropriate:

- The Flagstaff Fire Department provides outreach to the public and developers in the fuel management arena utilizing a number of mediums. The Fire Dept hosts a booth at the County Fair and during the Greater Flagstaff Home Show and provides information including suggested construction practices, materials and other safety efforts. Flagstaff works with the Greater Flagstaff Forest Partnership in providing mail-outs, inserts in pizza boxes, short promotional messages during movie intermissions, etc. In addition, Flagstaff provides presentations to civic groups and Homeowners groups on fire safety and fuel management efforts. Flagstaff hosts workshops with the various forest thinning contractors regarding code requirements and the permitting process. The Flagstaff Water Utilities Dept provides information and outreach to the public regarding water conservation measures and flooding. The City Council appointed Water Commission has public meetings on a monthly basis to convey these messages. The City has an annual public open house, in which all departments provide outreach and written information regarding the various mitigation efforts taking place throughout the City.
- Williams maintains a permanent website with a hazard mitigation link to the County's website. City hosts an annual meeting for all agencies and the public involved with the City's efforts to protect the community from natural disasters.



• Various departments within the City of Page establish booths at public events to distribute hazard awareness information appropriate to the event. Appropriate items will also be released to the local media as opportunities arise. These activities will be on a continuous basis and will involve all City of Page departments. The City of Page holds public meetings, makes public announcements, and distributes public safety brochures.

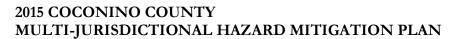


Appendix A: Plan Tools



Acronyms

ADEM	Arizona Division of Emergency Management
	Arizona Department of Environmental Quality
	Arizona Department of Water Resources
AGFD	Arizona Game and Fish Department
	Arizona Revised Statutes
	American Society of Civil Engineers
	Arizona State Emergency Response Commission
	Arizona State Land Department
	Arizona Department of Environmental Quality
	Arizona Geological Survey
	Bureau of Land Management
CAP	.Central Arizona Project
	.Community Assistance Program
	.Code of Federal Regulations
	.Community Rating System
	.Community Wildfire Protection Plan
	Arizona Department of Emergency and Military Affairs
	.Digital Flood Insurance Rate
DMA 2000	.Disaster Mitigation Act of 2000
DOT	.Department of Transportation
EHS	.Extremely Hazardous Substance
EPA	.Environmental Protection Agency
EPCRA	.Emergency Planning and Community Right to Know Act
FCDMC	.Flood Control District of Coconino County
FEMA	.Federal Emergency Management Agency
	.Flood Mitigation Assistance Grant Program
	.Geographic Information System
HAZMAT	.Hazardous Material
	.Hazards United States1999
	.Hazards United States Multi-Hazard
	.International Fire Code Institute
	.Local Emergency Planning Committee
	.Modified Mercalli Intensity
	.National Climate Data Center
	.National Drought Mitigation Center
	.National Environmental Satellite, Data and Information Service
	.National Flood Insurance Program
NFPA	.National Fire Protection Association
	.National Hurricane Center
	.National Institute of Building Services
	.National Inventory of Dams
	.National Institute of Standards and Technology
	.National Science Foundation
	.National Oceanic and Atmospheric Administration
	.National Response Center .National Weather Service
	.Palmer Drought Severity Index
KL	.Repetitive Loss





SARA	.Superfund Amendments and Reauthorization Act
	Severe Repetitive Loss Properties
SRL	.Severe Repetitive Loss
UBC	.Uniform Building Code
USACE	.United States Army Corps of Engineers
USDA	.United States Department of Agriculture
USFS	.United States Forest Service
USGS	.United States Geological Survey
WUI	.Wildland Urban Interface



Arizona Hazards

Dam Failure - a catastrophic type of failure characterized by the sudden, rapid and uncontrolled release of impounded water. Dam failures are typically due to either overtopping or piping and can result from a variety of causes including natural events such as floods, landslides or earthquakes, deterioration of foundation or compositional materials, penetration by vegetative roots or animal burrows, fissures or improper design and construction. Such a failure presents a significant potential for a disaster as significant loss of life and property would be expected in addition to the possible loss of power and water resources.

Drought - a deficiency of precipitation over on extended period of time, resulting in water shortage for some activity, group or environmental sector. "Severe" to "extreme" drought conditions endanger livestock and crops, significantly reduce surface and ground water supplies, increase the potential risk for wildland fires, increase the potential for dust storms, and cause significant economic loss. Humid areas are more vulnerable than arid areas. Drought may not be constant or predictable and does not begin or end on any schedule. Short term droughts are less impacting due to the reliance on irrigation and groundwater in arid environments.

Earthquake - a naturally-induced shaking of the ground, caused by the fracture and sliding of rock within the Earth's crust. The magnitude is determined by the dimensions of the rupturing fracture (fault) and the amount of displacement that takes place. The larger the fault surface and displacement, the greater the energy. In addition to deforming the rock near the fault, this energy produces the shaking and a variety of seismic waves that radiate throughout the Earth. Earthquake magnitude is measured using the Richter Scale and earthquake intensity is measured using the Modified Mercalli Intensity Scale.

Fissure - tension cracks that open as the result of subsidence due to severe overdrafts (i.e., pumping) of groundwater, and occur about the margins of alluvial basins, near exposed or shallow buried bedrock, or over zones of differential land subsidence. As the ground slowly settles, cracks form at depth and propagate towards the surface, hundreds of feet above. Individual fissures range in length from hundreds of feet to several miles, and from less than an inch to several feet wide. Rainstorms can erode fissure walls rapidly causing them to widen and lengthen suddenly and dangerously, forming gullies five to 15- feet wide and tens of feet deep.

Flooding - an overflowing of water onto normally dry land and is one of the most significant and costly of natural disasters. Flooding tends to occur in Arizona during anomalous years of prolonged, regional rainfall (typical of an El Nino year), and is typified by increased humidity and high summer temperatures.

Flash flooding is caused excessive rain falling in a small area in a short time and is a critical hazard in Arizona. Flash floods are usually associated with summer monsoon thunderstorms or the remnants of a tropical storm. Several factors contribute to flash flooding: rainfall intensity and duration, topography, soil conditions, and ground cover. Most flash flooding is caused by slow-moving thunderstorms or thunderstorms repeatedly moving over the same area and can occur within a few minutes or hours of excessive rainfall, or a quick release from a dam or levee failure. Thunderstorms produce flash flooding, often far from the actual storm and at night when natural warnings may not be noticed.

Landslide / Mudslide - Landslides like avalanches are massive downward and outward movements of slope-forming materials. The term landslide is restricted to movement of rock and soil and includes a broad range of velocities. Slow movements, although rarely a threat to life, can destroy buildings or break buried utility lines. A landslide occurs when a portion of a hill slope becomes too weak to support its own weight. The weakness is generally initiated when rainfall or some other source of water increases the water content of the slope, reducing the shear strength of the materials. A mud slide is a type of landslide referred to as a flow. Flows are landslides that behave like fluids: mud flows involve wet mud and debris.

Levee Failure / Breach – Levee failures are typically due to either overtopping or erosive piping and can result from a variety of causes including natural events such as floods, hurricane/tropical storms, or earthquakes, deterioration of foundation or compositional materials, penetration by vegetative roots or animal burrows, fissures, or improper design, construction and maintenance. A levee breach is the opening formed by the erosion of levee material and can form suddenly or gradually depending on the hydraulic conditions at the time of failure and the type of material comprising the levee.



Severe Wind - Thunderstorms are characterized as violent storms that typically are associated with high winds, dust storms, heavy rainfall, hail, lightning strikes, and/or tornadoes. The unpredictability of thunderstorms, particularly their formation and rapid movement to new locations heightens the possibility of floods. Thunderstorms, dust/sand storms and the like are most prevalent in Arizona during the monsoon season, which is a seasonal shift in the winds that causes an increase in humidity capable of fueling thunderstorms. The monsoon season in Arizona typically is from late-June or early-July through mid-September.

Tornadoes are violently rotating columns of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds in excess of 250 mph. Damage paths can exceed a mile wide and 50 miles long. The damage from tornadoes is due to high winds. The Fujita Scale of Tornado Intensity measures tornado / high wind intensity and damage.

Tropical Storms are storms in which the maximum sustained surface wind ranges from 39-73 mph. Tropical storms are associated with heavy rain and high winds. High intensity rainfall in short periods is typical. A tropical storm is classified as a hurricane when its sustained winds reach or exceed 74 mph. These storms are medium to large in size and are capable of producing dangerous winds, torrential rains, and flooding, all of which may result in tremendous property damage and loss of life, primarily in coastal populated areas. The effects are typically most dangerous before a hurricane makes landfall, when most damage occurs. However, Arizona has experienced a number of tropical storms that caused extensive flooding and wind damage.

Subsidence - Land subsidence in Arizona is primarily attributed to substantial groundwater withdrawal from aquifers in sedimentary basins. As the water is removed, the sedimentary layers consolidate resulting in a general lowering of the corresponding ground surface. Subsidence frequently results in regional bowl-shaped depressions, with loss of elevation greatest in the center and decreasing towards the perimeter. Subsidence can measurably change or reverse basin gradients causing expensive localized flooding and adverse impacts or even rupture to long-baseline infrastructure such as canals, sewer systems, gas lines and roads. Earth fissures are the most spectacular and destructive manifestation of subsidence-related phenomena.

Wildfire - a rapid, persistent chemical reaction that releases heat and light, especially the exothermic combination of a combustible substance with oxygen. Wildfires present a significant potential for disaster in the southwest, a region of relatively high temperatures, low humidity, low precipitation, and during the spring moderately strong daytime winds. Combine these severe burning conditions with people or lightning and the stage is set for the occurrence of large, destructive wildfires.

Winter Storm - Winter storms bring heavy snowfall and frequently have freezing rain and sleet. Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground or other hard surfaces. Freezing rain begins as snow at higher altitudes and melts completely on its way down while passing through a layer of air above freezing temperature, then encounters a layer below freezing at lower level to become supercooled, freezing upon impact of any object it then encounters. Because freeing rain hits the ground as a rain droplet, it conforms to the shape of the ground, making one thick layer of ice. Snow is generally formed directly from the freezing of airborne water vapor into ice crystals that often agglomerates into snowflakes. Average annual snowfall in Arizona varies with geographic location and elevation, and can range from trace amounts to hundreds of inches. Severe snow storms can affect transportation, emergency services, utilities, agriculture and basic subsistence supply to isolated communities. In extreme cases, snowloads can cause significant structural damage to under-designed buildings.

General Plan Terms

Asset - Any natural or human-caused feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.

Critical Facilities and Infrastructure - Systems or facilities whose incapacity or destruction would have a debilitating impact on the defense or economic security of the nation. The Critical Infrastructure Assurance Office (CIAO) defines eight categories of critical infrastructure, as follows: Telecommunications infrastructure, Electrical power systems, Gas and oil facilities, Banking and finance institutions, Transportation networks, Water supply systems, Government services, and Emergency services.



Disaster Mitigation Act of 2000 (DMA2K) - A law signed by the President on October 30, 2000 that encourages and rewards local and state pre-disaster planning, promotes sustainability as a strategy for disaster resistance, and is intended to integrate state and local planning with the aim of strengthening statewide mitigation planning.

Emergency Preparedness and Response (EPR) Directorate - One of five major Department of Homeland Security Directorates which builds upon the formerly independent Federal Emergency Management Agency (FEMA). EPR is responsible for preparing for natural and human-caused disasters through a comprehensive, risk-based emergency management program of preparedness, prevention, response, and recovery. This work incorporates the concept of disaster-resistant communities, including providing federal support for local governments that promote structures and communities that reduce the chances of being hit by disasters.

Emergency Response Plan - A document that contains information on the actions that may be taken by a governmental jurisdiction to protect people and property before, during, and after a disaster.

Federal Emergency Management Agency (FEMA) - Formerly independent agency created in 1978 to provide a single point of accountability for all Federal activities related to disaster mitigation and emergency preparedness, response and recovery. As of March 2003, FEMA is a part of the Department of Homeland Security's Emergency Preparedness and Response (EPR) Directorate.

Flood Insurance Rate Map (FIRM) - Map of a community, prepared by FEMA that shows the special flood hazard areas and the risk premium zones applicable to the community.

Frequency - A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1% chance – its probability – of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered.

Fujita Scale of Tornado Intensity - Rates tornadoes with numeric values from F0 to F5 based on tornado winds peed and damage sustained. An F0 indicates minimal damage such as broken tree limbs or signs, while an F5 indicates severe damage sustained.

Geographic Information Systems (GIS) - A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.

Hazard - A source of potential danger or adverse condition. Hazards include both natural and human-caused events. A natural event is a hazard when it has the potential to harm people or property and may include events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. Human-caused hazard events originate from human activity and may include technological hazards and terrorism. Technological hazards arise from human activities and are assumed to be accidental and/or have unintended consequences (e.g., manufacture, storage and use of hazardous materials). While no single definition of terrorism exists, the Code of Federal Regulations defines terrorism as "...unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives."

Hazard Mitigation - Cost effective measures taken to reduce or eliminate long-term risk associated with hazards and their effects.

HAZUS - A GIS-based nationally standardized earthquake, flood and high wind event loss estimation tool developed by FEMA.

Liquefaction - The phenomenon that occurs when ground shaking (earthquake) causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.

Mitigate - To cause to become less harsh or hostile; to make less severe or painful. Mitigation activities are actions taken to eliminate or reduce the probability of the event, or reduce its severity of consequences, either prior to or following a disaster/emergency.



Mitigation Plan - A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in a defined geographic area, including a description of actions to minimize future vulnerability to hazards.

Monsoon - A monsoon is any wind that reverses its direction seasonally. In the Southwestern U.S., for most of the year the winds blow from the west/northwest. Arizona is located on the fringe of the Mexican Monsoon which during the summer months turns the winds to a more south/southeast direction and brings moisture from the Pacific Ocean, Gulf of California, and Gulf of Mexico. This moisture often leads to thunderstorms in the higher mountains and Mogollon Rim, with air cooled from these storms often moving from the high country to the deserts, leading to further thunderstorm activity in the desert. A common misuse of the term monsoon is to refer to individual thunderstorms as monsoons.

100-Hundred Year Floodplain - Also referred to as the Base Flood Elevation (BFE) and Special Flood Hazard Area (SFHA). An area within a floodplain having a 1% or greater chance of flood occurrence in any given year.

Probability - A statistical measure of the likelihood that a hazard event will occur.

Promulgation - To make public and put into action the Hazard Mitigation Plan via formal adoption and/or approval by the governing body of the respective community or jurisdiction (i.e. – Town or City Council, County Board of Directors, etc.).

Q3 Data - The Q3 Flood Data product is a digital representation of certain features of FEMA's Flood Insurance Rate Map (FIRM) product, intended for use with desktop mapping and Geographic Information Systems technology. The digital Q3 Flood Data are created by scanning the effective FIRM paper maps and digitizing selected features and lines. The digital Q3 Flood Data are designed to serve FEMA's needs for disaster response activities, National Flood Insurance Program activities, risk assessment, and floodplain management.

Repetitive Loss Property - A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least \$1,000 each have been paid within any 10 year period since 1978.

Richter Magnitude Scale - A logarithmic scale devised by seismologist C.F. Richter in 1935 to express the total amount of energy released by an earthquake. While the scale has no upper limit, values are typically between 1 and 9, and each increase of 1 represents a 32-fold increase in released energy.

Risk - The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage beyond a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Substantial Damage - Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceeds 50% of the market value of the structure before the damage.

Vulnerability

Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power—if an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Vulnerability Analysis - The extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability analysis should address impacts of hazard events on the existing and future built environment.

Vulnerable Populations - Any segment of the population that is more vulnerable to the effects of hazards because of things such as lack of mobility, sensitivity to environmental factors, or physical abilities. These populations can include, but are not limited to, senior citizens and school children.



Appendix B: Planning Process Documentation





Coconino County Hazard Mitigation Plan Update Overview November 3, 2014

Board of Supervisor's Meeting Room 219 East Cherry Flagstaff, AZ

AGENDA

1:00pm

Welcome

Introductions

- Cocanina Caunty
- Flagstaff
- Fredonia
- Page
- Tusayan
- · Williams
- AZ Div of Emergency Management

What is Mitigation?

Mitigation Plan Purpose

Plan Benefits

DMA 2000 (DMA2K) Requirements

Plan Review/Update Process Expectations

- Planning Team & Process
- Community Descriptions
- Risk Assessment
 - Dam Failure
 - Drought
 - · Flood / Flash Flood
 - Severe Wind
- · Transportation Accidents
- Wildfire
- Winter Storm
- Mitigation Strategy
- Plan Maintenance

Update Timeline

5:00pm

Adjourn



		Phone	Initials
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Name & Agency	Email	Phone	Initials
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RICK LARSEN DEM.		828) CHS-HI13	A
Flagstaff P.D.	1 hundler @ coconing az sov (928) 213-3373	(928)213-3373	\$
PHIECHIESTIANSON	ECURISTIANSENCE GOOD	428-185-4451	RUC
Will Wright, Town of Tusagan	tisagantum numager e queil com	bab-889-82b	Crean
Deere Rills J	JEINO Frague 17- AZ. LOV	905% BIP 386	A
BRIAN TOOD WASHING	Campatitud 12 governiam cocrysi gace	1002481 846E	B



Coconino County Multi-Jurisdictional Hazard Mitigation Plan

Meeting of November 3, 2014 1:00 P.M. Coconino County Board of Supervisors Chambers 219 East Cherry Flagstaff, AZ. 928-679-8311

MINUTES

I. Introductions, Guests, and Sign-in, 1:00 p.m.

Welcome to the group by Robert Rowley, Coconino County Emergency Manager

Brief opening comments by Mark Christian, Emergency Management Program Coordinator and Introduction of Sue Wood, Mitigation Planning Manager, Arizona Division of Emergency Management

Agencies/organizations represented included City of Williams (Public Works and Emergency Management), City of Flagstaff (Police and Fire), City of Tusayan (Town Manager), City of Page (Police and Fire), Coconino County (Public Works, Emergency Management, Information Technology, Sheriff's Office, and Community Development), and Town of Fredonia (Marshalf's Office).

II. Presentation by Sue Wood

This was an overview of the Five Year Hazard Mitigation Plan Update process (with power point presentation and hand out provided for note taking).

Agenda covered the following topics:

- 1. Mitigation Plan Purpose and Benefits
- 2. What is Hazard Mitigation
- 3. Federal and State Requirements
- 4. Update Process:
 - -Planning Process
 - -Risk Assessment
 - -Mitigation Strategy
 - -Plan Maintenance
- 5. Timeline

III. Post presentation:

A question/answer session continued for approximately 30 minutes and was concluded at 4:30 P.M.

IV Next Meeting: is scheduled for Thursday January 15, 2014 at 8:00 A.M in the Board of Supervisors Chambers at 219 East Cherry, Flagstaff Arizona.





40000	1200
Robert L	Rowley
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AGENDA

Mark Christian Program Coominities 8:00am

Welcome

Ruthanne Fenn

Introductions

Admiredence

Alan Anderson

CERT Goordington

Coconino County

- Flagstaff
- Fredonia
- Page
- Tusayan
- Williams
- · AZ Div of Emergency Management

Overview

- · What is Mitigation?
- · Mitigation Plan Purpose
- · Plan Benefits
- DMA 2000 (DMA2K) Requirements

Plan Review & Update

- · Community Descriptions
- · Public Involvement
- · Program Integration
- · Hazards for Plan
- Hazards Prioritized
- Mitigation Actions & Projects

Next Meeting

12:00pm Adjourn

2.16 East Citienty Avenue, Flagstuff, AZ 96001-489€ • Phone 929 679 9911 • Fax 929 679 7195 • custopenous gryvisentivinoscenio





COUNTY ARIZONA EMERGENCY MANAGEMENT	Coconino County Hazard Mitigation Planning Mtg #1 January 15, 2015	County Planning Mtg #1 5, 2015	
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Coconino County Hazard Mitigation Planning Mtg #1

EMERGENCY MANAGEMENT	January	January 15, 2015	
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For Coconino County 219 East cherry Ave.

Flagstaff, Arizona (928) 679-8311

Meeting of January 15, 2015
Hirsch Training Room Highlands Fire
3350 Old Munds Highway
Flagstaff, AZ.
MEETING MINUTES

I. Introductions, Guests, and Sign-in, meeting started 0800

II Opening remarks thanking those present and organizational participation made by Coconino County Emergency Manager Robert Rowley. He stressed the importance of the review and update and commitment to complete this update process.

Opening remarks from Sue Wood from Arizona Division of Emergency Management:

Sue described the general process which will take approximately three meetings with much work to be completed between each. We have an advantage in that information needed is already in the current document and the major part of this process is to make it current. Community descriptions for Tusayan and Fredonia must be developed, and the descriptions for Page, Williams, Flagstaff and Coconino County must be updated. This update process now requires a discussion on climate change.

Completion of this plan will make participating organizations eligible to apply for hazard mitigation grants. Each participating jurisdiction in the plan must gain approval of the plan through their local governing body for FEMA approval. It is imperative that each participating jurisdiction choose the right individual (s) to commit to the process and represent their jurisdiction over the next several months to meet the deadline. The current plan expires in January 2016.

There are several Points of interest we need to address:

Examination of new and/or existing hazards, and whether or not we are we missing key stakeholders. Stakeholders we invite should be invited with a specific purpose for contribution.

We must give the public the opportunity to review and comment on the plan during planning process and at the draft stage prior to FEMA submittal. Many counties place their Hazard Mitigation plan on their website. We need to develop a paragraph or two announcing the update of the Hazard Mitigation with an explanation of:

What it is

Why we must update it

Explain what the plan does for the county and participating jurisdictions.

Clarify this plan is not an emergency response plan.

Tell the reader where the current plan can be found

Provide and explain where the public can comment on the plan and the process.

All public comments should be funneled to one point of contact. It was decided these comments will be sent to Coconino County Emergency Management, Mark Christian, and Program Coordinator. This public notice will also include an explanation for how members of the public in each jurisdictional may access this information via a link to the Coconino County website.

The remainder of this planning meeting focused on the individual sections of the Coconino County Hazard Mitigation Plan (the Plan).

Section One: Jurisdictional Adoption and FEMA Approval and Section Two: Introduction, will be combined and streamlined into one section to reduce unnecessary verhiage and total volume. There will be no loss of critical information.



Section Three: Planning Process. Mark Christian and Sue Wood will be the primary persons responsible for this section. All sub-sections need updating.

Section Four; Community Descriptions. The community descriptions as they exist in the present plan were distributed for review. The descriptions for Coconino County, Williams, Flagstaff, and Page should be updated and Tusayan and Fredonia will need to develop theirs. All Descriptions should be built and tailored to reflect more of the unique description of each community that sets it apart from others. These descriptions are ultimately up to the community. There was a brief discussion of the Section Four maps. We need to involve Coconino County GIS prior to our next meeting of February 17 and ask for their attendance to acquire an accurate description of the needed maps and what GIS can offer for this update.

The Section Four Climate discussion includes both graphs and tables. Sue offered that we could choose between one and the other in that we probably do not need both the graph and table to display the same information. The planning team needs to decide how to proceed.

Section Five: Risk Assessment. This section is extremely important.

Page 90, table 5-42 is a Summary of bazards to be mitigated by each participating jurisdiction. These hazards include Dam Failure. Drought, Flooding, and Sleet Freezing Rain, snow Storm, Severe Wind, Transportation Accidents, and Wildfire. The planning team reviewed section 5.2, Vulnerability Analysis Methodology, which included a discussion of the CPRI (Calculated Priority Risk Index). This review included a discussion of each existing hazard profile listed in the Plan. Each participating jurisdiction present was asked to review the numerous tables and be able to make a recommendation as to whether or not they are all needed.

Each jurisdiction was asked to select those hazards they felt applied to their community. This list prepared during the meeting and verified by Sue Wood. Sue will prepare this typed written list and forward it to Mark Christian for distribution to all participating jurisdictions.

Section Six: Mitigation Strategy

Mitigation involves long term solutions to reducing impact from hazards. This section will involve a great deal of review and update. The Actions and Projects status lists completed in October of 2014 by each of the jurisdictions presently listed in the Plan will be used as part of the review for this section. All jurisdictions must be sure to look at mitigation projects that should be added, and review those currently listed to determine relevancy to the updated plan. During this discussion decisions were made to include the existing current hazards:

Dam Failure, Drought, Flooding, Winter Storm. (this was changed from sleet/freezing rain),

Transportation Accident, Wildfire, and we added a new hazard: Hazmat.

The question was also posed as to whether or not Coconino County would in the future pursue an EMAP accreditation. I was asked to visit with Robert Rowley on this, the potential for listing two additional hazards to include Earthquake and Disease.

Sue briefly returned to the discussion of the hazard profiles as related to the now required (by the State) Climate change discussion. It was discussed documenting how climate change might affect individual hazards but then determined to be too comprehensive to begin with.

The Following Action Items were confirmed for completion prior to the next meeting:

-Public Information prepared for posting on the Coconino County website to provide information to the public on our review and update of the Plan. This posting will also include a link that can be made available to the participating jurisdictions to guide community residents to the Coconino County website for further information. (Mark)

Christian/County P1O)

- Work with Coconing County GIS on map needs. (Mark Christian and County GIS).
- -Community Descriptions: bull, revised and updated. (Each jurisdiction)
- -Climate change Information (Nancy Selover)
- -Calculated Priority Risk Index (CPRI) of all hazards (each jurisdiction)
- Make additions to the distribution list for the planning team. (Mark Christian)
- -Invitation to the next meeting (Mark Christian for February 17, Hirsch Room at 1:00 P.M.)
- -Discussion with Robert Rowley and Jeff Lee regarding adding the hazard of Disease (Mark Christian)

Mark Christian





Robert L. Rowley

Mark Christian Program Coonfinitor

Ruthanne Penn Admirodoliva Opposibili

Alan Anderson CERT Goordington Hazard Mitigation Planning Meeting #2 February 17, 2015 AGENDA

1:00pm Welcome

Introductions

- · Coconino County
- Flagstaff
- Fredoma
- Page
- Tusayan
- · Williams
- ASU
- · AZ Div of Emergency Management

Plan Review & Update

- · Community Descriptions
- · Public Involvement
- · Program Integration
- · Hazards for Plan
- · Hazards Prioritized (CPRI)
- · Hazard Profiles
- · Capability Assessment

Assignments

Next Meeting

5:00pm Adjourn

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MARK CACHARA	Fire Chirt	PONDERUSA FIRE	mark. Sachara@penelerusathe
Jeff Reed	Fike Chief	PAGE FILE DAPE.	Freehief & City of pregueral
Daniel Gamiso	MARSHAL TOWN FREEDING FREEDING WARSHALD	FRECEISIN MARSHALS	Barrier (mode) fredorig net (924) 643. 7513 (435) 689-011
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COUNTY ARIZONA EMERGENCY MANAGEMENT	Coconino County Hazard Mitigation Planning Mtg #2 February 17, 2015	County Planning Mtg #2 17, 2015	
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Rutham Pan	bolouin Asst	Coconino Co. Ewer, Hand	928-679.8311 Krown Dlamm, az. 901
ROBERT ROWLEY	Director	(43 0) 60 m(210)	628-474-8310
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Jeff Rud	Fire Chief	PAGE FIRE DIDE.	Frechief & city of page. 089
Will Wright	Mensier	Tusugan	928-488-7909
MARK SACHARA	Free Chart	Pawerusa Fire Drut	much sachara paderasa fire
Max CAILLARD	FIRCHOLY Son Mar City of FCASSAFF	City of F. CASSAFF	Mgw. Iland@flegshiffae.gov 928-853-384
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COCONINO COUNTY ARIZONA EMERGENCY MANAGEMENT	Coconino County Hazard Mitigation Planning Mtg #2 February 17, 2015	County Planning Mtg #2 17, 2015	
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1:00pm

Robert L. Rowley

Mark Christian Program Germinston

Ruthanne Penn Admir Strainle Episcolad

Alan Anderson CERT-Coordinator Hazard Mitigation Planning Meeting #3 April 14, 2015

Search & Rescue Bldg. 911 E. Sawmill Rd., Baker Training Room AGENDA

Welcome

Introductions

- · Coconino County
- Flagstaff
- Fredoma
- · Page
- Tusayan
- Williams
- · ASU
- · AZ Div of Emergency Management

Plan Review

Plan Progress Status

- Assignments
- · New Hazards
- Climate Change
- · Goals & Objectives
- · Past Mitigation Activities
- · Mitigation Activities for New Plan
- · Plan Maintenance
- · Public Involvement
- · Any other topics/issues

Next Steps

5:00pm Adjourn

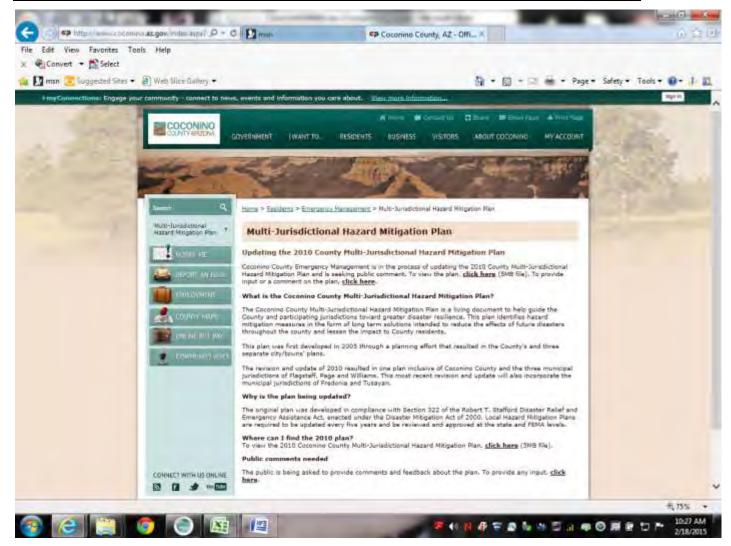
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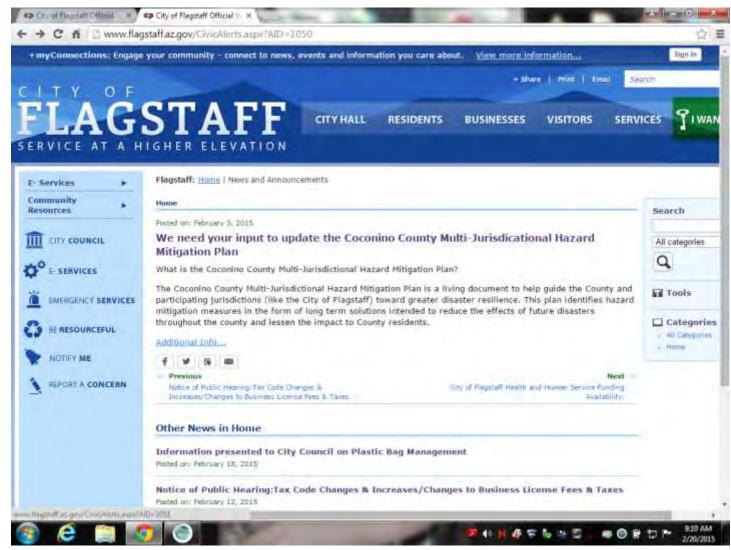
Name (PRINT CLEARLY)	April 14	Agency/Org	Email and/or Phone
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Dan Musselman	FRD Doply Chief	Flags to Ff	928-679-4068
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NIM Wright	Munager	Town of Tusagan	tusanga tour annager Commit
Joe Rumann	Eng. Supr.	Conga. Devel	928-679-8952
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Jeff Reed	Page Fino		
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Appendix C: Public & Stakeholder Involvement Documentation

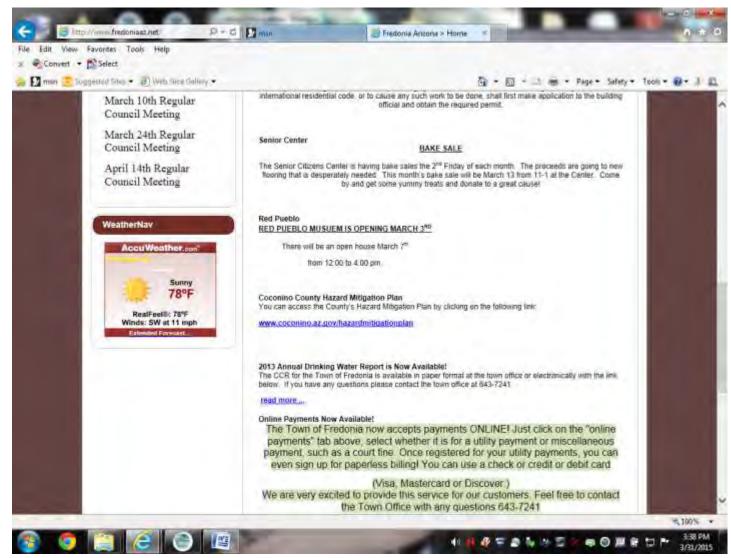














Short Cut to Summer Fun - Page-Lake Powell

US Route 89T is OPEN! This roadway fixes last year's closure of US 89 south of Page and it's almost exactly the same distance as the original road. Getting to Page has never been faster and this path across Navajo Nation land on Navajo Highway 20 has rarely been seen by outsiders. Highway 89 traffic is closed at the intersection of 89 and 89A. The new route on 89T is approximately 30 miles south of that closure. This intersection is easy to find – it is in the small Navajo community of Gap approximately 25 miles north of Cameron. Highway 89T is maintained by the Arizona Department of Transportation as a regular state highway open 24 hours a day with no travel restrictions.

Detour Map

The Arizona Department of Transportation did amazing work to accomplish this in such a short time. The new road and the reopening of Castle Rock Cut for Lake Powell boaters is welcome news for everyone." The path up lake for boaters will be as short as it has ever been with the completion of work by the National Park Service in April to deepen the Castle Rock Cut channel in the Wahweap Basin, a very popular point of departure for boaters. Opening this channel saves time and gas for boaters traveling up lake and returning to the Wahweap area. The Cut is opening just in time for what is forecasted as an exceptional spring fishing season.

Multi-Jurisdictional Hazard Mitigation Plan

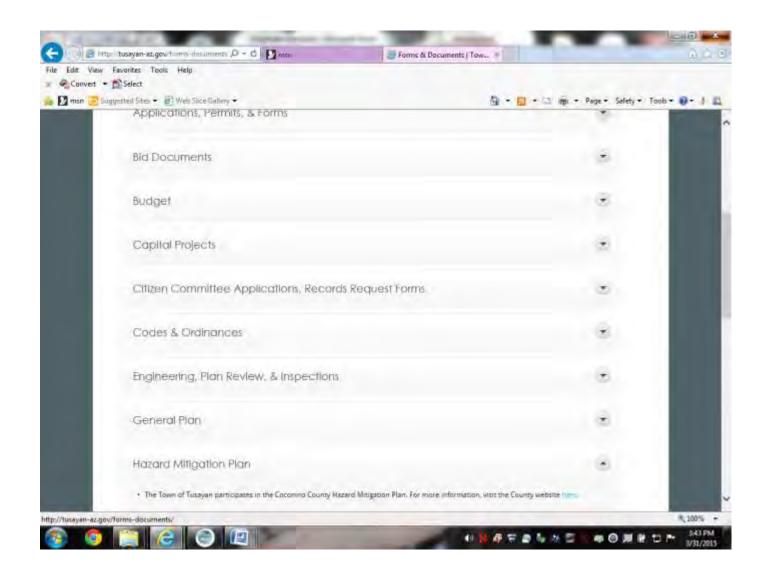
The Coconino County Multi-Jurisdictional Hazard Mitigation Plan is a living document to help guide the County and participating jurisdictions (including the City of Page) toward greater disaster resilience. This plan identifies hazard mitigation measures in the form of long term solutions intended to reduce the effects of future disasters throughout the county and lessen the impact to County residents. For more information or t.

Notice of proposed fees for licensing of commercial waste collection

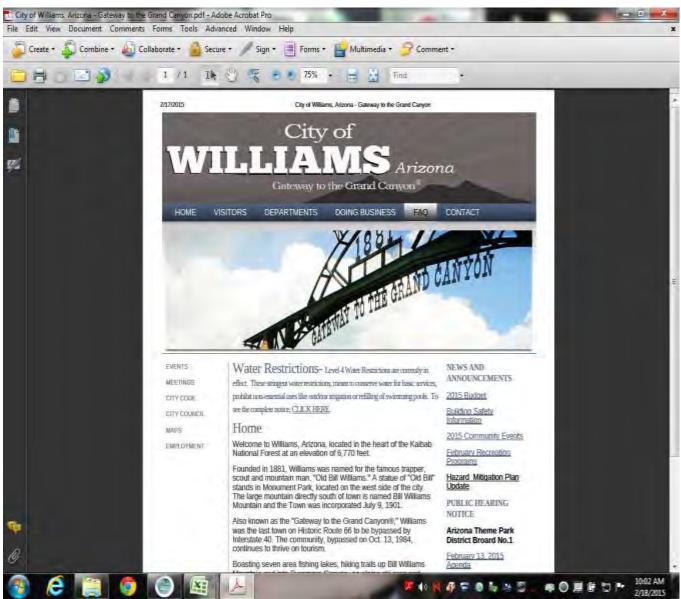
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Appendix D: Previous Mitigation Strategy Assessment





Description	Anticipated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	Status No Progress In Progress Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Floodplain re-mapping, including any local requests for map updates to provide the community with a regulatory tool to reduce the losses to property and people for Ft. Valley; Doney Park; Munds Park.	\$100,000 2016	County PW/ Flood Control District/ County Engineer	Flood District/General Funds	In Progress	Keep	Floodplain study for Munds Park and Kachina Village completed – currently with FEMA for review and issuance of new maps.
Develop neighborhood wildfire assessment and rank at-risk neighborhoods with the goal to provide accurate wildfire information to residents and motivate them to implement personal and neighborhood mitigation measures	\$150,000 On-going	WFAC/ PFAC	General Funds/ Health Forest Initiative Funds (AZ)	In progress	Keep	Ongoing by agencies within respective jurisdiction conducting surveys of communities, conducting thinning, lot clearing and delivering Firewise messaging. No special funding provided. Agencies are operating from normal budgets as available.
Educational programs and outreach to outlying areas of the county that are not currently served by any organized fire protection system with the goal to assist in organizing districts	\$20,000 On-going	All fire agencies	General Funds/ PFAC donations	In progress	Keep	No funding. This is a multi- Jurisdictional Effort, by agencies within their respective communities.
Establish and maintain a county component of the state GIS mapping system documenting forest treatments, hazard data, grants, etc.	\$50,000 2013	County Emergency Management	State grants/PDM	No progress	Keep	Several fire agencies at the local level are completing mitigation treatment projects. Reporting progress to the state for fuel treatment map purposes is not consistent. There is no state funding available to complete this project and no additional staff made available at the State or local level. County GIS is not





Status of Previous Plan's Mitigation Strateg	y for Coconino	County				
Description	Anticipated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	• No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
						involved in this project.
Bader Rd. Drainage Improvement. Design and construct culvert improvements to improve capacity and prevent flooding and washouts of road surface	\$500,000 2010	County Public Works/ County Engineer	Flood District Funds/General Funds	In Progress with Ft. Valley Area Study	Delete	Project now incorporated into Ft. Valley Area Study.
Timberline Trail Drainage Improvement. Culvert construction to improve the flood capacity and prevent washout of roads	\$850,000 2010	County Public Works/ County Engineer	Flood District Funds/General Funds	Complete	Delete	Project no longer needed due to completion of Schultz mitigation
Hillside Drive Phase II. Improve roadway with culvert construction to improve flood capacity and reduce threat of hazardous flooding event	\$900,000 2012	County Public Works/ County Engineer	Flood District Funds/General Funds	Complete As of October 2013	Delete	Project implementation completed October 2013.
Receive a Storm Ready Community designation for Coconino County from NOAA. Provide NOAA weather radios to all government buildings/ special needs population centers (ie, nursing homes, senior centers, etc)	\$5,000 2010	County EM/NOAA/ County Health	EMPG	Complete	Delete	Achieved Storm Recertification in 2012 inclusive of 2015. Will begin the application process for the new three year period at the end of 2015.
Public Information Grant for visitor brochures/ website improvement/ for hiking Havasupai Canyon	\$25,000 Unknown date	County EM/ADEM/ Havasupai Tribe/ NWS	PDM Grants/EMPGra nts/HUD tribal grants	No progress	Keep	No funding. Never initiated and not complete (Robert do we keep this?)
Flash Flood Early Warning System for hikers in Havasupai Canyon to alert campers of life threatening event in canyon- Feasibility Study and Implementation	\$200,000 Unknown date	County EM/ADEM/NWS/T ribal EM	PDM/ HUD/EMPG Funds	No progress	Keep	No funding. Never initiated and not complete (Robert Keep this or delete??)
Implement Local Area Drought Impact Group to develop drought Impact and Response Guidelines and Mitigation Plan	\$20,000/ Staff Time Unknown	County EM. ADWR/ County Extension Agent	General Funds	No progress	Keep	No funding. Never initiated and not complete





Status of Previous Plan's Mitigation Strateg	y for Coconino	County				
Description	Anticipated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	• No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Conduct roadside thinning along Forest Highway 3 (Lake Mary Road), Perkinsville Rd, Old Munds Hwy, Garland Prairie, and Spring Valley Rd to reduce vulnerability to the effects of wildfire	\$778,182 2017	Public Works / County Engineer	HURF Funds	In progress	Keep	Project implementation on FH 3 began in spring 2014, but is currently on hold due to contract dispute between ADOT and contractor. Likely ADOT will have to re-bid the project. All other roads complete.
Enforcement of floodplain management requirements in accordance with the NFIP, including regulating all and substantially improved construction in floodplains to reduce the losses to property and people.	Staff Time Ongoing	County Engineer Community Development	General Funds/Flood District	On-going	Keep	Ongoing through building permit process
Expand education activities to include N AZ Home Show, public service announcements, public access TV, website	\$35,000 ??? On-going	County Emergency Management/ County EM	EMPG/General Funds/ title III	In progress	Keep	Education and Outreach addressing emergency preparedness
Develop additional GIS data layers including Sedona and Winona areas to facilitate future revisions of the greater Flagstaff area Community Wildfire Protection Plan	\$25,000 2013	Greater Flagstaff Forest Partnership/ PFAC	CCPW/ USFS grants	In progress	Keep	Arizona WRAP may contribute to this
Elk Place & Hillside Drive Culvert constructed to low water crossings to control road flooding and life hazard to residents	\$50,000 2013	County Public Works/ County Engineer	Flood District Funds/General Funds	Complete	Delete	Project implementation completed October 2013.
Snowbowl road/Rio deFlag crossing. Construction of box culverts to improve flood capacity and reduce threat of washouts and life safety of drivers	\$500,00	County Public Works/ County Engineer	Flood District Funds/General Funds	No progress	Delete	Project now incorporated into Ft. Valley 104 Study.
Winter Weather Preparedness Campaign/ Brochures developed for Public/PSA/ Webpage Input	\$2,000/ Staff Time 2010 ?????	County EM/ County PW ?????	Hazard mitigation grant funds	On-going	Keep	Ongoing. Any future expenditures will come from normal operating budget absent grant funding or





Description	Anticipated Cost & Completion Date	Project Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
				•	•	emergency declarations.
Mountainview/Rancho Drainage project Feasibility Study for new development	\$210,000 2012	County Public Works/ County Engineer	Flood District Funds/General Funds	No progress	Delete	Project no longer needed.
Kona Trail Storm Water/Sewer/Sidewalk Drainage Improvement Project. Install stormwater drainage	\$650,000 2011	County Public Works/ County Engineer	Flood District Funds/General Funds	No progress	Delete	Project now incorporated into Kachina / Mountainaire 104 Study.
Havasu Hilltop Shelter Facility to serve as a refuge during major flooding events for residents and visitors to the canyon.	\$1,000,000 2014	County EM/ BOS	PDM/ tribal Funds	No progress	Delete	No funding. Not complete
Partner with the Greater Flagstaff Forests Partnership to conduct outreach and attract sustainable, small-diameter wood-based businesses into the area	\$150,000	GGFP/ Chairman of the Board	Federal Grants	No progress	Delete	No funding. Not an active project.
Commodity Flow Study for State Hwy 89 from Utah Boundary to Flagstaff	\$100,000	County EM/ AZSERC	HMEP Grant/Homelan d Security Grants	No Progress	Keep	No funding. Not complete

Status of Previous Plan's Mitigation Strategy for Flagstaff



Description	Lead Agency Estimated Cost & Comp Date	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Upgrade existing conservation measures to provide for water during periods of drought. Flagstaff depends on surface reservoirs and groundwater for domestic water supply. Conservation efforts expand the capacity of this limited resource.	Water Utilities Dept/ Conservation Manager \$250,000 / On-going	On-going	Keep	The Flagstaff Watershed Protection Project is underway, reclaimed water is required for large area irrigation and lawn watering restrictions are in place. A water harvesting rebate program was started in July 2012. Water conservation outreach was presented to all students at the fourth grade level.
Enhance flood mitigation efforts through channelization and detention. Due to drainage patterns and topography many areas of the city are subject to periodic flooding during snow melts and monsoon periods.	Storm Water Manager \$5,400,000 / 2015	On-going	Keep	The Clay Avenue Wash Basin flood mitigation dam was completed. The Linda Vista/Rainer Street and drainage project was completed.
Remove trees that may promote the severity or rapid spread of catastrophic wildfire. The Flagstaff area is susceptible to annual wildfires.	Fire Dept/Wildland Fire Management Officer \$10M / On-going	On-going	Keep Revise	Hazard Mitigation activities (selective thinning, debris disposal, prescribed fire, hazard trees). Involves internal city stand-alone efforts as well as collaborative efforts with our partners (Ex: Four Forest Restoration Project, Greater Flagstaff Forests Partnership).
Provide equipment and human resources sufficient to handle comprehensive road, air, and railway hazmat and mass casualty incidents. Nearly 120 trains travel through the Flagstaff boundaries each day. I-40 and I-17 generate truck traffic that carry hazardous materials through the city each day.	Fire Dept/Training Chief \$250,000 / On-going	On-going	Keep	Flagstaff FD continues to train, equip, and respond to transportation and fixed site emergencies throughout Northern Arizona.
Educate the local and regional community (including tourists) about the consequences of catastrophic wildfire and necessary prevention methods. Our area is prone to wildfires and most are human caused.	Fire Dept /Firewise Coordinator \$750,000 / On-going	On-going	Keep Revise	Firewise Neighborhood and Fire-Adapted-Community programs, Annual Restrictions & Closure Plan, Annual Wildfire Preparedness Day, Flagstaff Wildland-Urban Interface Fire Code, general outreach efforts and events.
The Rio DeFlag Project is a major flood control initiative designed to remove 1500 structures from the flood plain. The downtown area is prone to flooding and this effort will reduce the flood threat and enable further economic development in this area.	Capital Improvements/Rio DeFlag Project Manager \$30,000,000 / 2015	Valuation has changed, will update in 2015	Keep	The design phase is ongoing with coordination from the Army Corps of Engineers, but funding has not been secured yet.





Status of Previous Plan's Mitigation Strategy for Flagstaff									
Description	Lead Agency Estimated Cost & Comp Date	Status No Progress In Progress Complete	Disposition Keep Delete Keep, revise	Explanation or brief description of work so far or reason for 'no progress'					
Install generators for water wells vulnerable to losing power during wildfires. More than 60% of the water supply is pumped from underground wells. Many of these well fields are subject to wildfire threats that disrupt power.	Water Utilities/Division Head \$3,500,000 / 2012	In progress	Keep	The generator project for the Tuthill well is out to bid. A mobile unit is available for deployment to be used at the Shop well. The Woody Mountain well and Lake Mary well will be next to upgrade with back- up generators.					
Construct & equip a multi-agency EOC to coordinate disasters. The area is subject to periodic disasters. On an annual basis the EOC is activated 2-3 times each year.	Fire Dept/Fire Chief \$2,000,000 / When funding becomes available	In progress	Keep	The alternate Emergency Operations Center (EOC) is currently under construction,					
Expand the roadway de-icing program to reduce vehicular accidents during winter storm conditions. Flagstaff has frequent freeze-thaw conditions on its roadways and the frequency of vehicular accidents increases during these events.	Public Works Dept/Roads Supervisor \$500,000 / On-going	No progress	Delete	Lack of funding					
Floodplain identification and mapping, including any local requests for map updates to provide the community with a regulatory tool to reduce the losses to property and people.	Storm Water/Storm Water Manager \$100,000 / 2016	On-going	Keep	All Flood Insurance Rate Maps (FIRM) have been updated and converted to Digital Flood Insurance Rate Maps (D-FIRM), to help enforce flood plain regulations. We completed the Northeast area Master Drainage Study, a master plan to conceptually identify and mitigate major flooding in Northeast Flagstaff.					

Status of Previous Plan's Mitigation Strategy for Page									
Disposition									
		Status	• Keep						
	Lead	Agency • No Progress	• Delete	Explanation or brief description					
		osed Cost • In Progress	• Keep,	of work so far or reason for 'no					
Description	Proposed	Comp Date • Complete	revise	progress'					





Status of Previous Plan's Mitigation Strategy for Page								
Description	Lead Agency Proposed Cost Proposed Comp Date	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'				
To prevent loss of essential government data in the event of a prolonged loss of electrical power, a power generating system shall be installed to support all critical computer systems. To prevent a breakdown of government function in the event of a natural disaster, terrorism or other civil disobedience, an off-site backup system for critical data from the City's three main servers for police, fire, and government shall be researched, installed, and maintained.	Community Development/ Building Official \$250,000 2012	No progress		Delayed due to fiber optic installation, waiting on quotes. Possibly complete June 2015, June 2016.				
The city will develop a plan, pamphlets and implement a public information program that will identify the following: who can apply? What types of emergencies can be applied for? Where to apply.	Risk Management-Human Resources/ Public Info. Officer \$100,000 2012	No progress		Lack of funding				
Construction Mitigation from drainage study for (LOMR). Construct any channels, berms, bank stabilization, etc. which arise from the drainage study.	Engineering Dept/ City Engineer \$2,500,000 2014	No progress		Lack of funding				
Water Supply System Upgrades. This project is to upgrade the current pumping units and possibly identify an alternative lower level intake with a new pumping system and a separate pipeline to deliver water to the water treatment plant. This will allow for dependability and backup to the current system. It will also provide water if the lake level drops below the current intake levels.	Engineering & Utility Dept/ City Engineer-Utility Director \$5,000,000 2014	No progress		Lack of funding				
Design and Construct drainage structures for problem flood areas throughout the City to prevent flooding of properties and buildings.	Engineering & Public Works/City Engineer-Pubic Work Director \$2,500,000 2013	No progress		Lack of funding				
Provide equipment and other resources sufficient to provide initial response to major road, air, hazardous materials and mass casualty incidents.	Fire Department \$125,000 2014	No progress		Lack of funding				
Replace 1984 Utility truck equipped with hazmat and human resource support supplies and equipment. Unit is light and air truck plus is used to tow hazmat and/or technical rescue trailer to scene of incident.	Fire Department	No progress		Lack of funding				





Status of Previous Plan's Mitigation Strategy for Page								
Description The city will develop a plan and mutual aid agreements with the state, county, Navajo Nation, National Park Service and other governmental entities as necessary to implement mitigation actions.	Lead Agency Proposed Cost Proposed Comp Date Community Development/ Building Official \$100,000 2011	Status • No Progress • In Progress • Complete In progress	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress' 40% complete				
Page Fire Dept will develop a public awareness program. Handouts and presentations will be developed and presented at area clubs, schools, and other public gatherings. Goals of the project shall include increasing public support for funding disaster preparation, educating the public what to do in case of a disaster, and increasing public awareness as to how public safety agencies will respond in a disaster.	Fire Department \$15,000 2013	Complete	Delete	June 2013				
Drainage Study for Letter of Map Revision (LOMR). The drainage study will provide information to allow our flood maps to be revised to the actual conditions. The new maps may remove properties from the flood zone which would make the purchase of flood insurance voluntary instead of mandatory.	Engineering Dept/ City Engineer \$40,000 2012	Complete	Delete	July 2011				
Investigate the benefits and join the NFIP.	Engineering Dept/ City Engineer \$10,000 2010	Complete	Delete	June 2012				

Status of Previous Plan's Mitigation Strategy for Williams								
Description	Hazard(s) Mitigated	Estimated Cost & Completio n Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'	
Enforcement of floodplain management requirements, including regulating all and substantially improved construction in	Flood	Staff Time On-going	Planning and Building Code Enforcement/	General Fund	In Process	Keep	Implementation through	





Status of Previous Plan's Mitigation Strategy for Williams

Description	Hazard(s) Mitigated	Estimated Cost & Completio n Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)	Status No Progress In Progress Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'	
floodplains to reduce the losses to property and people.			Building Official				Building codes	
Continue to enforce zoning and building codes through current site plan, subdivision, and building permit review processes to reduce the effects of drought, flood, severe wind, wildfire, and other hazards on new buildings and infrastructure.	Multiple	On-going	Planning and Building Code Enforcement/ Building Official	General Fund	In Process	Keep	Implementation through Building codes	
Perform fuel thinning around water treatment plant to create a wildfire defensible space perimeter, and install exterior sprinkler system on the structures and site perimeter.	Wildfire	\$285,000 2015	Public Works/ Director	General Fund	In Progress	Keep	Thinning is complete, sprinklers complete in FY16/17	
Annual Inspections and Maintenance work on five existing city dams. Continued monitoring by the City Water Department in cooperation with ADEQ.	Dam Failure	\$100,000 On-going	Public Works/ Director	General Fund	In Process	Keep		
Continued planning as part of the annual Snow Removal Plan. This planning effort continues every year in advance of the winter season and includes inventorying and maintenance of existing snow removal vehicles, plows, cutting edges, chains, and other equipment. The City also contacts local contractors to identify resources in the	Winter Storm	\$100,000 On-going	Public Works/ Director	General Fund	In Progress	Keep		





Status of Previous Plan's Mitigation Strategy for Williams

Status of Frey load Fam 5 Mingation Strategy for Williams									
Description	Hazard(s) Mitigated	Estimated Cost & Completio n Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'		
event of a major snow storm.									
Continued tree and shrub pruning around power lines, telephone lines, and other infrastructure as part of regular Town maintenance.	Winter Storm	\$300,000 On-going	Public Works/ Director	General Fund	In Progress	Keep	Work with APS to mitigate Hazard trees on a yearly maintenance program		
Support of USFS, State and County fuel treatment activities by providing City equipment and manpower resources.	Wildfire	\$75,000 On-going	Public Works	General Fund	Complete	Delete	Complete		
Enforcement of the newly adopted Defensible Space Ordinance for the protection of future and existing structures within the wildland urban interface.	Wildfire	\$25,000 On-going	Planning and Building Code Enforcement/ Building Official	General Fund	In Progress	Keep	Implementation through Building codes		
Perform public outreach activities, including fliers, town hall meetings, safety fairs, and others to educate the public on wildfire protection activities and best management practices.	Wildfire	\$5,000 On-going	Public Works/ Director	General Fund	In Progress	Keep			
Create new storage facilities for effluent to be used for irrigation and emergency wildfire protection.	Wildfire	\$50,000 2015	Public Works/ Director	General Fund	In Progress	Keep	Creating additional effluent storage at WWTP by rehabilitating old wasting lagoons. \$100,000 FY15/16		